
This is a reproduction of a library book that was digitized by Google as part of an ongoing effort to preserve the information in books and make it universally accessible.

GoogleTM books

<https://books.google.com>



TVA

TENNESSEE VALLEY AUTHORITY

[1]
DRAFT

ENVIRONMENTAL

STATEMENT



MORTON RANCH URANIUM MINING

NEPA COLLECTION
Transportation Library
Northwestern University Library
Evanston, IL 60201





Tennessee Valley Authority

[1] DRAFT ENVIRONMENTAL STATEMENT

MORTON RANCH

URANIUM MINING

Chattanooga, Tennessee

**SUMMARY SHEET
ENVIRONMENTAL STATEMENT
MORTON RANCH URANIUM MINING
CONVERSE COUNTY, WYOMING**

(X) Draft () Final environmental statement prepared by the Tennessee Valley Authority. For further information, get in touch with:

Dr. Peter A. Krenkel, Director
Division of Environmental Planning
268 401 Building
Chattanooga, Tennessee 37401
(615) 755-3161

1. (X) Administrative Action () Legislation Action
2. This action is the mining of the uranium deposits at Morton Ranch in Converse County, Wyoming, to provide nuclear fuel for TVA's nuclear electricity generating plants.
3. The environmental impact of the action will consist of land disturbance, fugitive dust generation, and noise during construction, mining, and reclamation, discharge of combustion gases from mining and support equipment and vehicles, land erosion, temporary change in land use and local plant and animal species diversity, some socioeconomic impacts, ultimate minor alterations in the specific topographic features at the surface mining areas, depression of groundwater levels and increase in surface water runoff due to dewatering operations and increased levels of dissolved minerals in rainwater-runoff until overburden is reclaimed.
4. Alternatives to the proposed action which were considered were to take no action, to purchase uranium, and to mine other properties. TVA has concluded that mining of the Morton Ranch uranium deposit is necessary in order to help assure a dependable long-range supply of uranium fuel.
5. Comments are being requested from the following agencies:

Department of Agriculture	Energy Research and Development
Department of Commerce	Administration
Department of Health, Education, and Welfare	Federal Energy Administration
Department of Housing and Urban Development	Interstate Commerce Commission
Department of Interior	Nuclear Regulatory Commission
Department of Labor	
Department of Transportation	Wyoming State Planning Coordinator
Environmental Protection Agency	
6. The draft statement was sent to the Council on Environmental Quality and made available to the public on October 2, 1975.

TABLE OF CONTENTS

<u>Title</u>	<u>Section</u>
Introduction.	1.0
Proposed Action	2.0
Existing Environment.	3.0
Land Use.	3.1
Geology	3.2
Soils	3.3
Hydrology and Water Quality	3.4
Climatology, Meteorology, and Air Quality	3.5
Biology	3.6
Historical and Archaeological Significance.	3.7
Socioeconomy.	3.8
Other	3.9
Environmental Impacts	4.0
Land Features and Uses.	4.1
Geologic Impacts.	4.2
Hydrological and Water Quality Impacts.	4.3
Impacts to Vegetation and Wildlife.	4.4
Socioeconomic Considerations.	4.5
Other	4.6
Mitigating Measures	5.0
Proposed Reclamation Planning and Procedures.	5.1
Other Mitigating Measures	5.2

<u>Title</u>	<u>Section</u>
Adverse Environmental Effects Which Cannot be Avoided . . .	6.0
Alternatives to the Proposed Action	7.0
Short-term Uses Versus Long-term Productivity	8.0
Irreversible and Irretrievable Commitments of Resources . .	9.0
Conclusions	10.0

1.0 INTRODUCTION

The Tennessee Valley Authority (TVA) is a corporate agency of the United States created by the Tennessee Valley Authority Act of 1933 (48 Stat. 58, as amended, 16 U.S.C. §§ 831-831dd (1970; Supp. III, 1973)). In addition to its responsibilities for flood control, navigation, and regional development, TVA operates a power system supplying the electrical requirements of about 6.7 million people living in an area of approximately 80,000 square miles. Except for direct service to certain industrial and Federal installations with large or unusual power requirements, TVA's electricity is supplied to the ultimate consumers through 160 municipalities and rural electric cooperatives that purchase their electricity from TVA. TVA is interconnected at 26 points with neighboring utility systems, and provides support in time of power emergency to an area that extends from the Great Lakes to the Gulf of Mexico, and from New England to Oklahoma and Texas.

The TVA electrical generating system consists of 29 hydrogenerating plants, 12 fossil-fueled steam generating plants, 4 gas turbine peaking plants, and 1 nuclear-fueled steam generating plant. An additional 4 nuclear plants containing 10 light water reactors are under construction or in the design-planning stage. Two additional nuclear plants, containing 4 units have been authorized but have not yet been sited.

In order to provide an adequate supply of uranium fuel to operate TVA's constructed and planned nuclear-fueled electric generating plants, it has become necessary for TVA to seek additional supplies beyond those

available on the open market. TVA has purchased a 50 percent undivided interest in the Morton Ranch, Wyoming, uranium properties from the United Nuclear Corporation (UNC) and Teton Exploration and Drilling Company, Incorporated (Teton), a subsidiary of UNC. TVA proposes to participate with UNC in mining uranium from these Morton Ranch properties. Mining activities would begin sometime in 1976.

Woodward-Clyde Consultants, acting as consultants for TVA, supplied much of the information and base line data utilized in this environmental statement.

2.0 PROPOSED ACTION

The proposed action is the mining of the uranium deposits located on the Morton Ranch in Converse County in eastern Wyoming. Both surface and underground mining methods will be used to extract the uranium ore, and in-situ leaching is contemplated in some areas. Construction of both surface and underground mine facilities will begin as soon as practical to allow for commencement of actual ore production by the middle of 1977. Mining is expected to continue until at least 1987, when presently known ore reserves are expected to be exhausted. Mining will continue past that date if present reserves are increased on the property.

Current calculations indicate economic ore reserves at a minimum of 3.4 million tons containing 11.4 million pounds of uranium oxide (U_3O_8) are present on the Morton Ranch properties. Exploration and development drilling is continuing on the property and it is anticipated that discovery of additional ore bodies, and extensions of present known deposits will result from this work. In addition, reclassification of present sub-ore grade material to ore grade material may be accomplished by on-going evaluations of changing economics and improved mining technology.

To extract the present reserves, a production rate of 375,000 tons per year is anticipated. With an increase in the reserves, this production rate could be expanded to 575,000 tons per year.

Several alternatives are currently being evaluated to determine an optimum milling arrangement that will best satisfy the environmental, mineral resource conservation and economic criteria involved. It may be necessary to temporarily stockpile some of the uranium ore production pending finalization of the milling arrangement.

1. Location - The Morton Ranch uranium property is in central Converse County, Wyoming. Glenrock and Douglas, the nearest incorporated towns, are about 20 air miles southwest and 22 air miles south-southeast, respectively, of the property. The nearest major city is Casper, about 50 air miles west-southwest of the property (Figure 2.0-1).

The leased property encompasses approximately 26,000 acres, which represents approximately 10 percent of the 250,000 acres comprising the total Morton Ranch. The presently proposed mining area is divided into two separate tracts (Figure 2.0-2). The northern tract covers approximately 3500 acres, the southern tract covers approximately 21,500 acres, and there are about 1000 acres in outlying areas of Morton Ranch. The Highland uranium mine and mill, operated by Exxon Company, U.S.A., is located between these two tracts.

Except for two full sections and portions of two other sections (approximately 1480 acres) owned by the State of Wyoming, the surface and mineral rights of the Morton Ranch property are held by various private parties. The project property includes tracts with title to mineral rights derived under both patented (pending)

and unpatented mining claims. For the project properties, lease agreements have been obtained from the State of Wyoming. Fee mineral rights have been obtained from various private parties. Ownership of the surface and mineral rights on the Morton Ranch uranium property is presented in Table 2.0-1.

Initially, surface (open pit) and possibly adit level underground mines are planned for the southern property and underground mines for the northern property. The initial surface mine will be located in Section 15, T35N, R72W; the initial underground mine shaft will be located in Section 14, T36N, R73W.

The several small outlying properties comprising approximately 1000 acres (Figure 2.0-2) are considered to have potential for discovery of uranium ore deposits. While no mining is presently planned for these properties, the environmental information given in this report is applicable to them. If developable ore bodies are found, mining would be undertaken in a similar manner as described in this statement; and with similar precautions.

2. Nature and Extent of Mineral Deposits - Both uranium deposits and other minerals on the project site are discussed below.

a. Uranium Deposits - The uranium ore bodies on the leased properties occur typically as geochemical cell or roll front deposits in feldspathic to arkosic sandstone host rocks. In plan section, the individual ore deposits are elongated pods with the length from 10 to 40 times the width. On the northern property,

the deposits are 550 to 700 feet below the ground surface with an average thickness of about 10 feet. On the southern property, the currently delineated deposits lie at depths of between 40 and 280 feet below ground surface with thicknesses ranging from 2 to 25 feet.

On the leased property, three uranium minerals: coffinite, zippeite and liebigite, have been identified through analysis of rock core samples. These minerals occur primarily as coatings on the individual grains which comprise the sandstone host rock.

It is presently estimated that at least 3.4 million tons of uranium ore containing 11.4 million pounds of uranium oxide underlie the Morton Ranch property; about 1.3 million tons of ore reserves containing 6.1 million pounds of uranium oxide are located in the area of the underground mining site, and about 2.1 million tons of ore reserves containing 5.3 million pounds of uranium oxide have been delineated in the surface mining area. The weighted average grade of all the presently estimated uranium ore considered economical for extraction on the property is about 0.168 percent.

b. Minerals Other than Uranium - At the present time, there are no producing oil or gas wells on the Morton Ranch uranium property. Although one to three thin seams of lignite (generally less than 18 inches in thickness) are present in the stratigraphic sequence overlying the sandstone host rocks of the uranium deposits, extraction of the lignite does not appear to be commercially feasible.

3. Proposed Mining Plans - Proposed mining plans for both underground and surface mining are given below:

Underground Mining - Because of the depth and relatively small size of the ore body, underground mining is presently considered to be the most feasible method of extracting the uranium ore underlying the northern portion of the Morton Ranch uranium property. Current plans call for underground mining operations to begin by early 1977, with an initial production rate of 250 tons of ore per day. Projected production may increase to 500 tons of ore per day by 1980 and would remain at this rate until 1987, when presently known ore reserves are expected to be exhausted. Mining will continue past this date if the presently known reserves are increased.

A modified room and pillar method with sublevel haulage is presently planned as the principal underground mining technique to be utilized. Table 2.0-2 lists typical equipment that is likely to be used. Initially, an 8-ft.-diameter shaft is planned to be drilled and steel-lined to a depth of about 720 ft. on the southwestern side of the ore body. At approximately 60 ft. above the bottom of the shaft, a mining station will be excavated and production facilities installed. At this station level, the facilities will include slusher trenches, mine water collection points and pumping equipment. Below this level, a skip loading pocket will be constructed adjacent to the shaft. The remaining portion of the shaft below the skip pocket facility will be utilized as a sump.

From this mining station level a main haulage drift will be driven at a shallow upward gradient underneath and along the axis of the ore body. (Figure 2.0-3). Present plans are to utilize a continuous mining machine to excavate all drifts (Figure 2.0-4). At spaced intervals, short vertical raises will be driven up from the haulage drift through the ore body. These raises will be divided into two compartments; ore pass and man way. From the top of the raise, a development drift will be driven at the base of the ore body parallel to the sublevel main haulage drift to intersect the next spaced raise. Additional development drifts will be driven at right angles from this development drift to the lateral limits of the ore body. Ore mined during the excavation of these development drifts will be mechanically loaded into 5-ton trucks, hauled along the development drifts and dumped into the ore pass raise. The ore will then be gravity loaded into mine rail cars from the ore passes and transported via tracked haulage equipment to the mining shaft station where it will be dumped into the slusher trenches, loaded into the skip through the loading pocket and hoisted to the surface. Small loaders and mucking machines are planned for cleaning up the rock and waste debris in the main haulage and development drifts. At this time the development phase for this portion of the ore body is essentially completed and the production phase commences.

The modified room and pillar method of mining involves the removal of pillars (blocks) of ore while leaving adjacent pillars of ore or waste as support. When an appropriate area has been developed, the first ore pillar will be removed. This is done by first supporting

the roof in the previously opened drift area with roof bolts and wire mesh, timber sets and/or backfill and then excavating the pillar. Present plans are to use continuous miners to excavate the ore pillars (Figure 2.0-4). When the pillar removal is accomplished, the roof in the area previously occupied by the ore pillar will be supported by repeating the roof support cycle as above. Adjacent ore pillars are removed in a sequence to allow safe retreat to the appropriate ore pass. Ore mined during the production phase will be transported to the surface as described above.

Permanent roof support in the mine, according to present plans, will consist of timbersets, roof bolts and wire mesh and/or steel arches. These permanent supports will be used principally in the main haulage ways and shaft stations.

Blasting in the underground mine is not presently planned on a regular basis, if at all, because it is presently believed that both the ore and the surrounding barren rock are soft enough to permit the use of continuous mining machines. Ore from the underground mine will be stockpiled as necessary on surface ore pads.

Mine ventilation will be provided by several axivane-type blowers mounted in 4-ft.-diameter ventilation and escape shafts, which will be upreamed from the main mine workings to the surface, at approximately 2000-ft. intervals along the long axis of the ore body (Figure 2.0-4). Present plans are to draw air down the main hoisting shafts, through the mine, and out through the ventilation/escape shafts. The total ventilation rate for the mine will be approximately 50,000 cubic feet per minute (ft. ³/min.).

A total of 130 people will probably be employed in the underground mining operation. Under current plans, 7 people working one-8 hour shift, 5 days a week, will be involved in mine development. When sufficient development is completed, a total of 111 people working two-8 hour shifts, 5 days a week, will be involved in ore production. The remaining 12 people will be management and office personnel and members of the repair crews who will work in both the surface shops and the mine.

Surface Mining - Current plans call for surface mine operations to begin by early 1977 with an initial production rate of 500 tons of ore per day. Production is planned to increase to 1,000 tons of ore per day by mid-1979 and remain at that rate until 1987 when presently delineated ore reserves would be exhausted. Exploration drilling is continuing on the southern area with final production rates and schedules contingent upon additions to known reserves and completion of milling arrangements.

Surface mining will consist of excavating several small open pits (Figures 2.0-5 and 2.0-6). Typical equipment that might be used in the operation is listed in Table 2.0-3. The first open pit will occupy approximately 32 acres: subsequent mining will disturb about 66 surface acres each year. Figure 2.0-7 shows the mining sequence for the first 3 years of operation in the initial group of pits and indicates where other known mineralized areas are located on the property. These other areas will be mined after the ore in the first group of pits is depleted.

The first phase of excavating, the removal of topsoil from the mining and spoil areas, will be performed by push-loaded scrapers and bulldozers or self-loading scrapers.

The topsoil will be stockpiled for future reclamation operations and will be seeded with fast-growing plants to reduce erosion losses. The overburden will then be removed with bulldozers and push-loaded scrapers; significant blasting is not anticipated. An average of about 27,000 cu. yd. of overburden will be removed each work day, under the presently proposed ore production rates, and placed in designated spoil piles. The spoil piles will be constructed with a maximum slope of 33 percent (3:1, horizontal to vertical). After a spoil pile has been prepared for reclamation, it will be covered with topsoil and revegetated, as discussed in Section 5.1. As surface mining progresses, overburden from successive pits will be backfilled into the older pits.

When the overburden has been removed, the uranium ore will be mined with hydraulic backhoes or front-end loaders. The ore is located in as many as three unconsolidated sand units, which are typically coarse to very fine-grained and poorly sorted. The uranium ore is located by the use of a gamma radiation detection device. The individual ore deposits are marked with flagged stakes. Backhoes and small front-end loaders will remove and load the ore into ore haulage units, which will haul it to previously prepared stockpile areas located on the surface near the pit.

Under certain circumstances, it may be necessary to drive adit level drifts into the wall at the toe of an open pit to recover

small, narrow ore pods. Generally, these drifts are expected to be less than 100 feet long. The adits will be timbered, with portal sets extending into the open pit to provide adequate protection against pit wall sloughing. The mining technique will be similar to the underground method described above; however, because of the narrow widths of the ore pods, the majority of the ore will be mined in the development phase and only relatively small pillars will have to be removed.

A work force of approximately 125 will be employed for the open pit development and production ore operation. Of this number, approximately 92 people will work two-8 hour shifts, 5 days a week, removing the topsoil and overburden. Mining of the ore body will employ approximately 17 people working one-8 hour shift, 5 days a week. The remaining 16 people will be office staff or will work in the repair shops.

An additional 28 people will comprise the overall mine administrative staff and exploration team, bringing the total to approximately 283 people during the presently anticipated full-scale mining operations.

In-Situ Leaching - In-situ leaching of uranium ore involves the drilling of injection and recovery wells into the ore body from the surface. An acid or carbonate solution is pumped down the injection wells into the ore-bearing strata. This leach solution dissolves the uranium minerals coating the rock grains; and the uranium-bearing solution is then recovered by pumping it back to the surface through the recovery wells. Uranium deposits on the property which are small, isolated, and too deep to be economically mined by

conventional methods may be recovered by in-situ leaching if the following conditions can be met:

- Uranium ore is in a generally horizontal bed underlain by a relatively impermeable stratum
- Uranium ore is in a saturated stratum below the static water table
- Direction and velocity of the regional groundwater flow is known
- The fluid transmissivity and storage capability of the ore-bearing sand are known
- Mineralogy of the ore is determined so that its amenability to the proposed process may be known
- Mineral content of the area is sufficient to repay the anticipated cost of operation
- Water quality impacts are investigated
- There is a minimal nonrecovery of the acid or alkaline leach solution
- The in-situ mining plan is modified to mitigate any expected water quality impacts to insignificant levels

4. Surface Facilities - Surface support facilities such as leach pads, underground and surface mine water installations, roads, and utility services are discussed below:

Leach Pad - Sub-ore grade material will be segregated during the mining operations, stockpiled, and at some future date, may be placed on a pad with impervious sides and bottom, and leached of its contained uranium with acid or alkaline solutions.

Underground and Surface Mine Water Removal Facilities -

Facilities will be required for underground mine dewatering and for removal of water from the surface mine. These facilities, as well as facilities for temporary holdup of this water, are discussed below.

Underground Mine Dewatering Facilities - Before and

during mining, the underground mine area will be dewatered by several wells (see Figure 3.2-2 for location) ranging from 4 to 8 inches in diameter which will be pumped at a rate of about 100 to 150 gal./min. each. Additional dewatering will be performed by removing drainage from the mine sump. The water will be placed in holding ponds for storage and potential later usage as a potable water supply, if satisfactory for this purpose.

Surface Mine Water Removal Facilities - At the surface

mine, a drainage system will be used to minimize the accumulation of surface water and to control runoff in the open pit and around the spoil piles. The system will include:

- Dikes and ditches to direct surface runoff away from the open pit area.
- Drainage ditches constructed at the toes of the spoil piles to collect any runoff from the piles.
- Sump pumps and piping systems to remove water from the floors of the open pit mines and pump it to settling ponds.

Figure 2.0-8 shows a typical layout of surface water control facilities around an open pit mine and spoil pile area.

Holding Ponds - The holding ponds will act as sedimen-

tation basins to remove solids prior to use and/or discharge.

If the water from the holding ponds meets applicable water standards and a permit is obtained under the National Pollutant Discharge Elimination System as implemented by the Water Quality Division of the Wyoming Department of Environmental Quality, it will be discharged into Box Creek or Cowell Draw. If necessary, it will be treated prior to release.

Roads - Figure 2.0-9 shows the locations of present and proposed roads on the Morton Ranch uranium property. Roads will be constructed to provide access to the proposed underground and surface mine sites and the spoil pile areas. These roads will occupy a total surface area of approximately 55 acres. At the present time, they are planned to be constructed of compacted overburden surfaced with coarse sand or other suitable material. The site access roads will be approximately 40 to 60 feet wide and will be elevated 1 to 3 feet above ground level to provide good drainage, minimize snow drifting, and enhance safe driving conditions. Haulage roads would be approximately 30 feet wide. All roads will have culverts where they cross major drainage channels. Drainage ditches will be constructed alongside the roads. Active haul roads will be well maintained.

Utility Services - The utility requirements for the proposed mines and their surface support facilities include electric power, gas, telephones, industrial and potable water, and sanitary sewage. Figure 2.0-9 shows the locations of existing and proposed utility corridors and rights-of-way on the mine property.

Electric power required at the underground and surface mine sites will tentatively be supplied by the Pacific Power and Light Company via a 34,500-volt (V) primary transmission line. A transformer substation will be installed at the initial underground mine site to reduce voltage to 4160 V, 480 V and other required voltages for use at the underground mine. A 34,500 V line will also be run to the surface mine area where the voltage will be reduced to the required voltages to accommodate the power needs there. Adequate grounding to ensure safe operation will be built into the system at circuit breakers, transformer banks, and switching points. The estimated connected electrical load for the underground mine site is about 2250 kVA and for the surface mine, about 200 kVA.

A 16-in. high-pressure intrastate gas line runs along the western boundary of the Morton Ranch property. Present plans are to supply natural gas to the underground mine site by a spur from this line. A 6-in. high-pressure gas line presently extends eastward from the 16-in. line across the southern Morton Ranch uranium property. It is contemplated that a spur from this 6-in. line will be extended to the surface mine shop area.

Two alternatives have been proposed for the construction of inter-connecting telephone systems for the northern and southern portions of Morton Ranch property. A telephone microwave tower has been installed between the two tracts by the Mountain Bell Telephone System. One alternative would be to tap into the system at the tower and run lines north and south. A north-south Mountain Bell system

trunk line from Douglas, Wyoming, is now being constructed east of the Morton Ranch uranium property. Mountain Bell has plans for construction, in the near future, of a buried telephone line west from the north-south trunk line and along the existing six inch high-pressure gas line, across the northern part of the South Morton uranium property to the existing Bell System microwave station. A second alternative would be to tap this east to west line directly north of the surface mine facilities for telephone service to this area. Telephone service to the northern portion of the property would still be provided by a tap at the microwave tower. At present, it is anticipated that the telephone lines will be buried.

Both potable and industrial water required at the underground and open pit mine sites will be provided by onsite facilities. The projected 2000 gal./day potable water requirement for use at the underground mine surface facility will be supplied from the mine dewatering operation. The projected 1500 gal./day potable water requirement for the surface mine facilities will be supplied by a well about 250 ft. deep, drilled near the shop area. All potable water will meet applicable standards. Industrial water, supplied from the surface and underground mines, will among other uses, be utilized for dust suppression on active haul roads. Maximum use of water for dust suppression might approach 40,000 gal./day during the summer. Little of this water will run off because of the porous nature of the materials used to construct the haul roads.

An approved sanitary sewage system utilizing septic tanks discharging into leach fields for final sewage disposal will be constructed at the underground and surface mine sites. The disposal facility at the underground mine site will consist of a septic tank and a 50,000 ft.² leach field. This facility will accommodate in excess of 5,000 gallons of sanitary sewage daily. At the surface mine site, a similarly constructed disposal facility will accommodate in excess of 2,500 gallons of sanitary sewage daily. Septic tank areas and leach fields will be flagged or fenced to prevent vehicular traffic on these areas.

Office and Shop Buildings - A single-story steel-paneled building is presently planned to be constructed at the underground mine site. It will have approximately 6000 sq. ft. of floor space and will be set on a concrete slab foundation. The building will contain a double-drum 200-hp mine hoist, mine offices, change rooms for mine personnel, warehouse, surface shops for the underground mine, first-aid station, a 200-hp air compressor, and a 350 kW emergency electrical generator (Figure 2.0-10).

A 90-ft.-high enclosed headframe will be situated over the main shaft of the underground mine. It will be steel-fabricated with two compartments containing a headframe sheave with two ore bins, into which the 60-cu.-ft. skip will dump ore and waste material. The skip will be operated by the mine hoist in the main building.

The surface mine facilities are presently planned to consist of fuel storage tanks and a steel-frame structure having approximately

7000 sq. ft. of floor space which will be erected on a concrete slab foundation (see Figure 2.0-11). The structure will house administrative offices, mine warehouse, and equipment repair shop. The fuel-storage tanks will be capable of storing at least 10,000 gal. of fuel each with a maximum project storage capacity of 100,000 gal. of fuel. The tanks will be built above ground and will be enclosed by earthen dikes constructed of low-permeability soils. The dikes will be of sufficient size to contain the maximum fuel-storage tank capacity, as required by Federal and state regulations.

Small explosive-storage magazines may be constructed on the surface and will be located in compliance with Federal and state requirements. These magazines will provide safe storage for any explosives that might be required for the project.

5. Fire Protection - Each automotive-type vehicle used in the mining operation will be equipped with a 5-lb. ABC dry-type fire extinguisher. The stripping and mining vehicles will be equipped with 10-lb. ABC dry-type fire extinguishers. There will be 20-lb. ABC dry-type extinguishers in the surface and underground mine shops, warehouse, offices, and change rooms. One or two 125-lb. ABC dry-type wheeled units and fire hoses will be located at the surface and underground mine surface facilities. An automatic sprinkler system is currently planned for the buildings.

Until a small fire truck is obtained, the water truck used for dust control will be equipped with fire hoses. A fire-fighting crew will be trained.

The open pit and underground mining operations will comply with the applicable safety requirements promulgated under the Federal Metal and Nonmetallic Mine Safety Act (30 U.S.C. §§ 721-740).

TABLE 2.0-1

OWNERSHIP OF SURFACE AND MINERAL RIGHTS ON MORTON RANCH
PROPERTY

	Surface Rights	Mineral Rights
Patented Mining Claims	1,495	1,495
Unpatented Mining Claims	11,250	11,530
State of Wyoming	1,480	1,480
Fee Lands	11,539	11,539
TOTAL	25,764	26,044

TABLE 2.0-2

TENTATIVE UNDERGROUND MINING EQUIPMENT

Description	No. of Units	Power	Brake Horsepower	Operating Hours/Week per Unit
Continuous miners	2	Electric	90 (67.1 kW)	80
2-yd loaders	3	Diesel	110	80
5-ton trucks	6	Diesel	57	80
Mucking Machines	3	Air	-	-
Locomotives	2	Diesel	85	80
Rail Cars	14	-	-	80

TABLE 2.0-3

TENTATIVE SURFACE MINING EQUIPMENT

No. of Units	Description	Power	Brake Horsepower	Operating Hours/Week per Unit
<u>Equipment Used in Removing Overburden and Topsoil</u>				
15	32-cu-yd scrapers	Diesel	445	80
9	Crawler tractors	Diesel	375	80
2	Motor patrols	Diesel	250	80
1	Water truck	Diesel	445	20
1	Lubrication truck	Diesel	220	40
1	Fuel truck	Diesel	220	40
1	Portable welder	Gasoline	90	40
1	Winch truck	Diesel	190	10
1	Mechanic truck	Gasoline	175	60
4	Light plants	Gasoline	10	30
23*	Cars	Gasoline	175	20
1	Tire truck	Diesel	220	40
<u>Mining Equipment</u>				
1	Water truck	Diesel	445	10
2	Self-loading scrapers	Diesel	335	40
1	Motor patrol	Diesel	180	40
2	Crawler tractors	Diesel	240	40
2	Diesel $1\frac{1}{2}$ -cu-yd hydraulic backhoes	Diesel	208	40
7	35-ton ore trucks	Diesel	335	40
1	Fuel truck	Diesel	200	20
1	Grease truck	Diesel	200	20
1	Welder truck	Gasoline	160	10
1	Portable welder	Gasoline	90	10
1	Ambulance	Gasoline	175	-0-
1	1-ton mechanic truck	Gasoline	175	40
7	Pickups	Gasoline	175	40
8*	Cars	Gasoline	175	20
1	6-yd front-end loader	Diesel	325	40
2	35-ton ore trucks	Diesel	335	80

*Includes employees' personal cars being used for transportation to and from work.

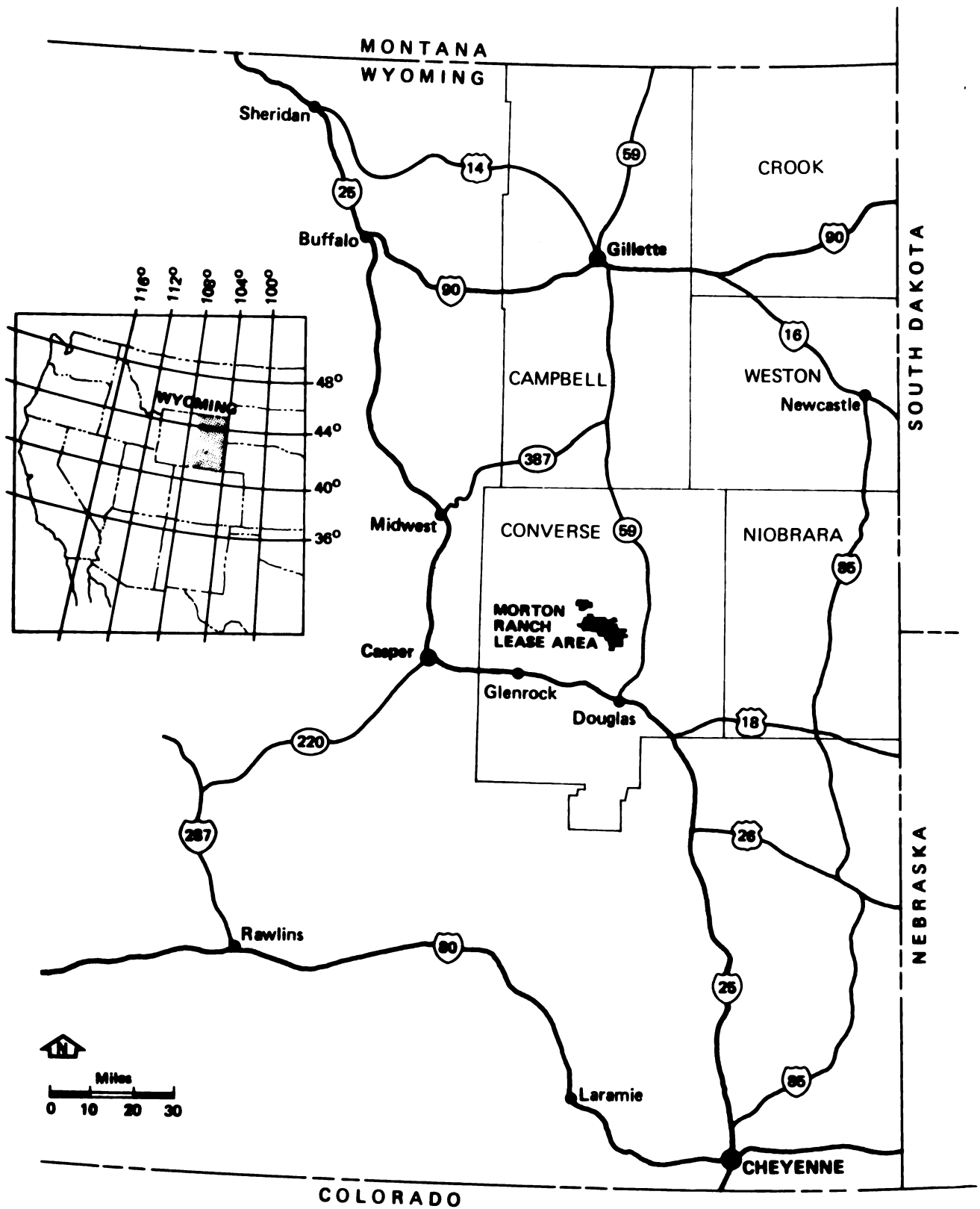
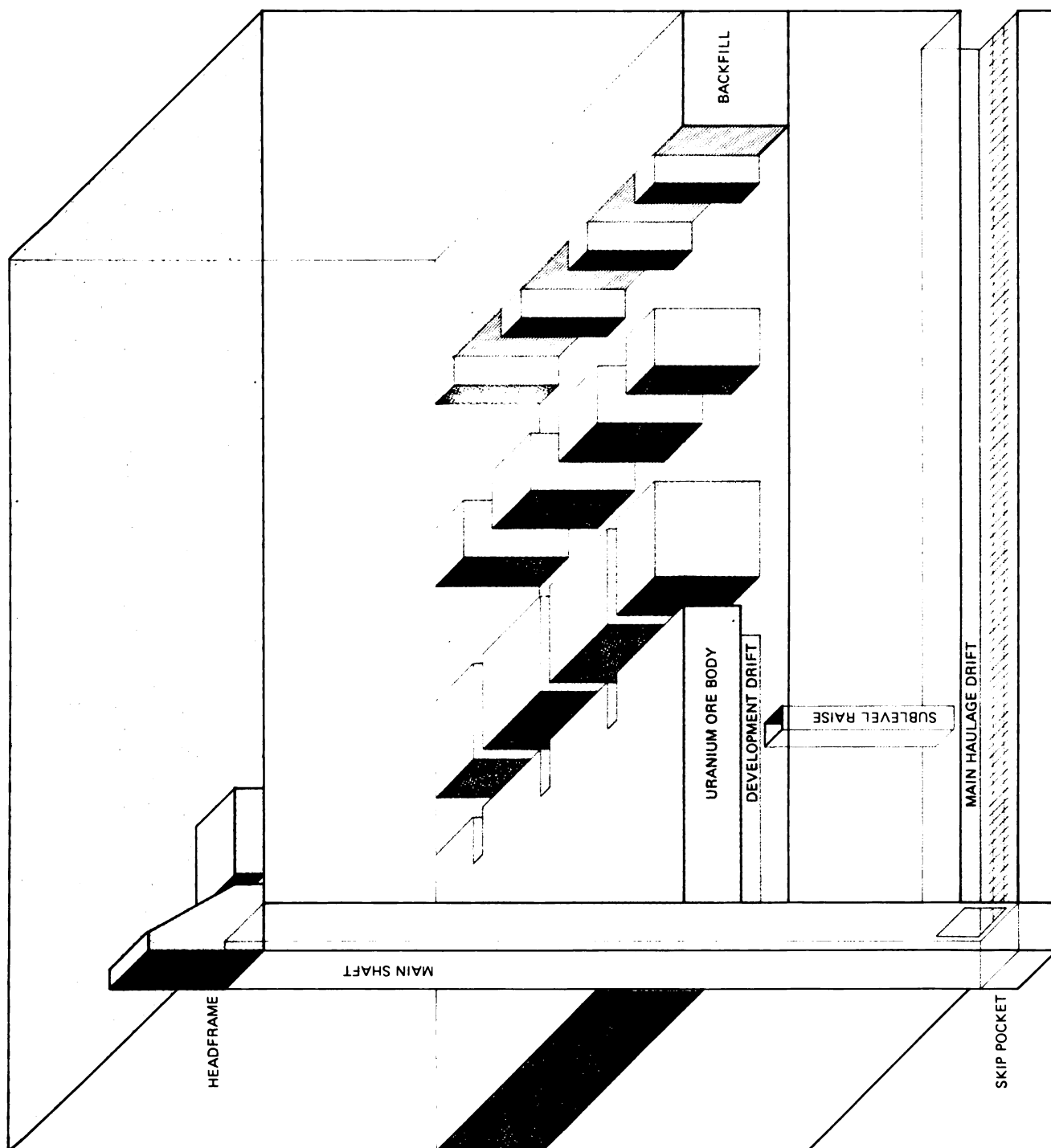


Figure 2.0-1 REGIONAL LOCATION OF THE MORTON RANCH URANIUM PROPERTY



2.0-3 SCHEMATIC ILLUSTRATION OF THE UNDERGROUND MINE

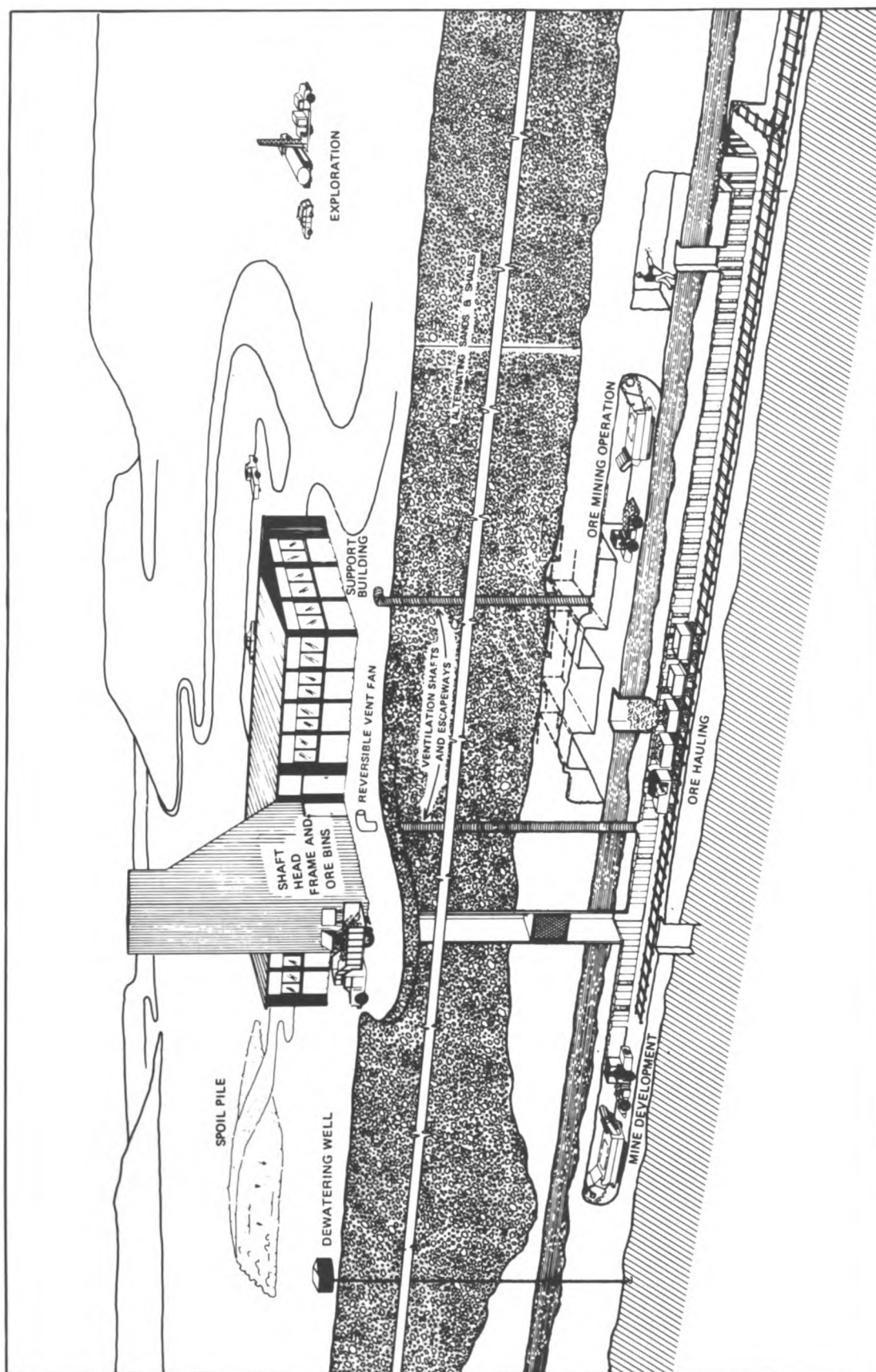


Figure 2.0-4 ARTIST'S CONCEPTION OF UNDERGROUND MINING OPERATION AND SURFACE FACILITIES

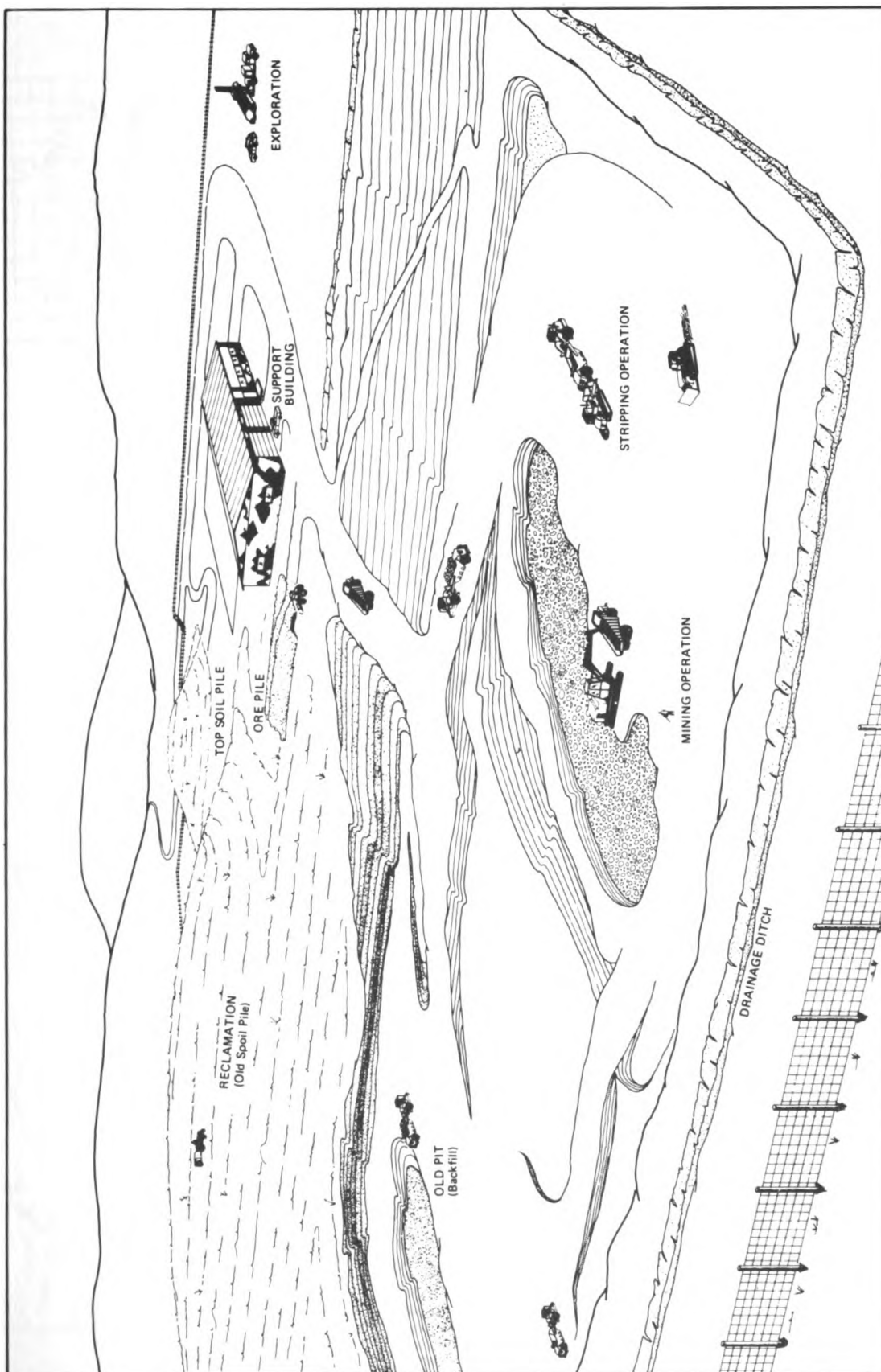


Figure 2.0-5 ARTIST'S CONCEPTION OF OPEN PIT MINING OPERATION AND SUPPORT FACILITIES

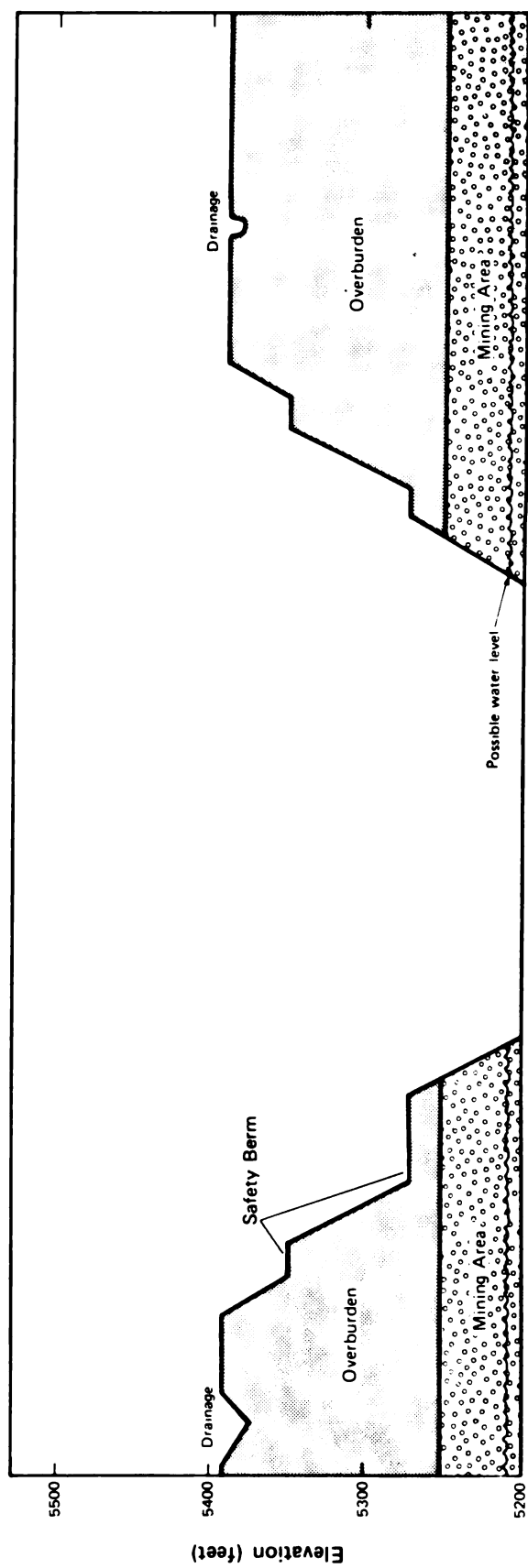
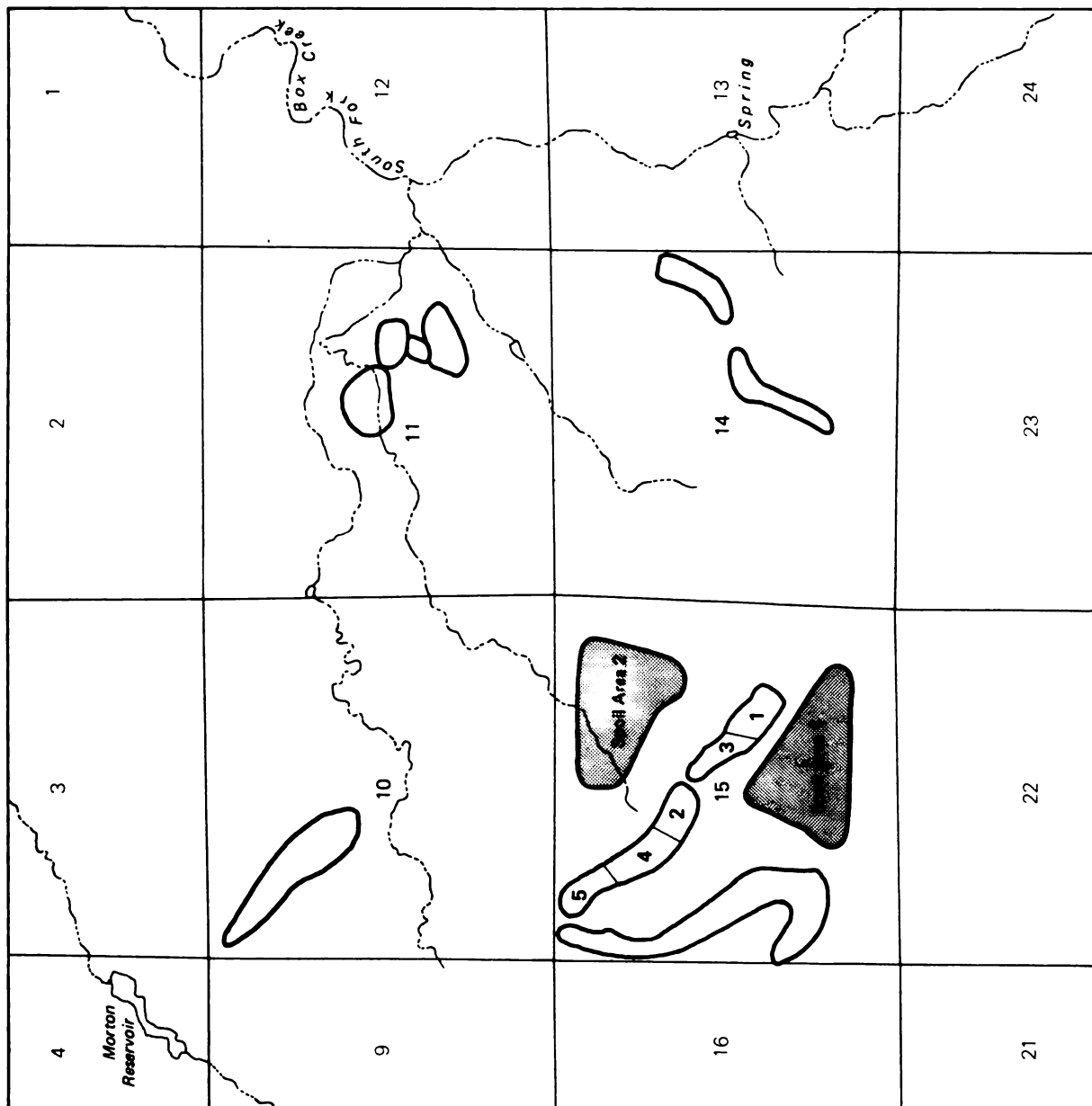


Figure 2.0-6 SCHEMATIC CROSS SECTION OF SURFACE MINING OPERATIONS

R 72 W



POTENTIAL ORE BODIES
MINING SEQUENCE

2.0-7 PROPOSED OPEN PIT MINING SEQUENCE AND LOCATIONS OF OTHER POTENTIAL ORE BODIES IN THE SOUTHERN PORTION OF THE MORTON RANCH PROPERTY

T 35 N

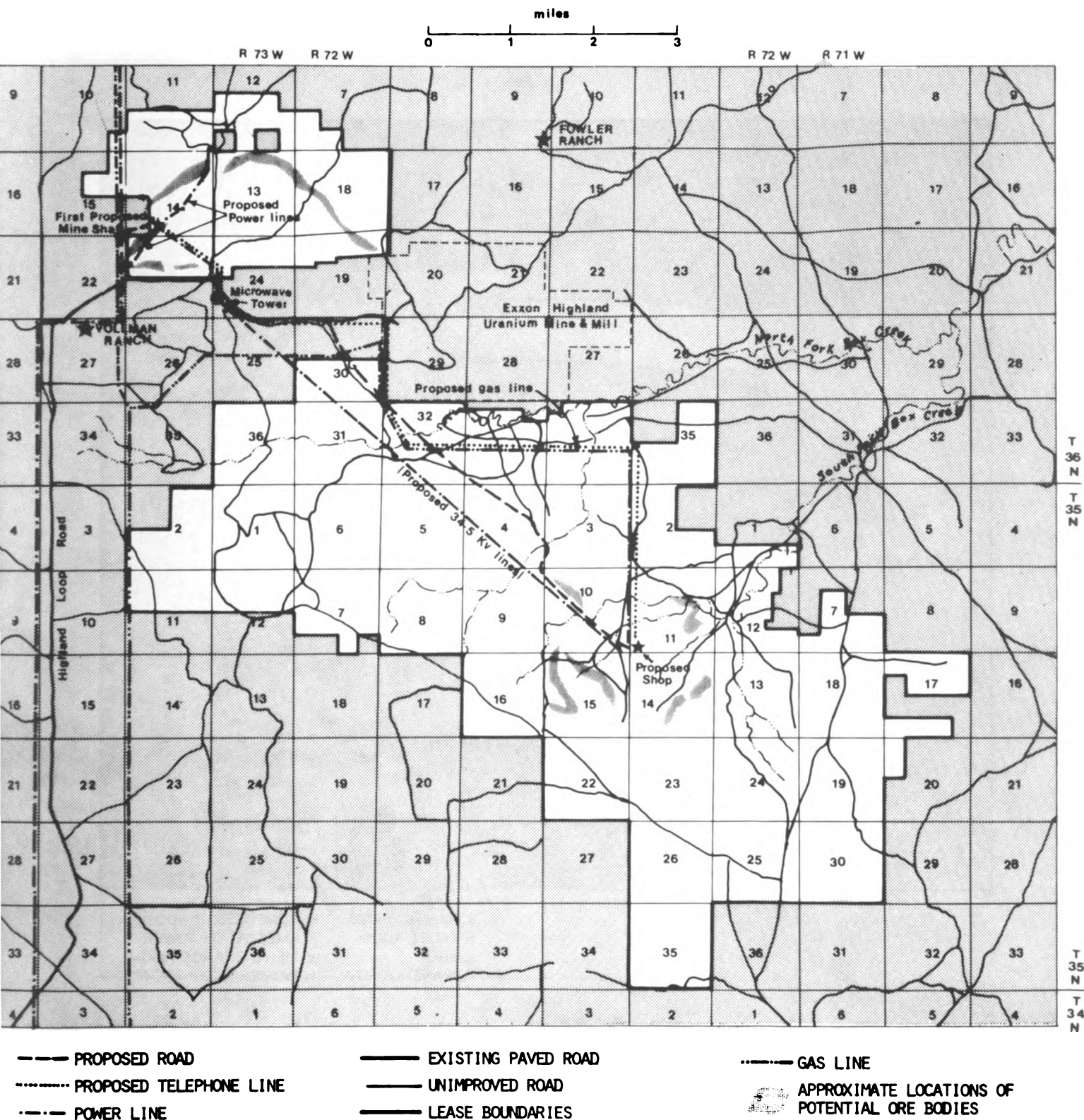
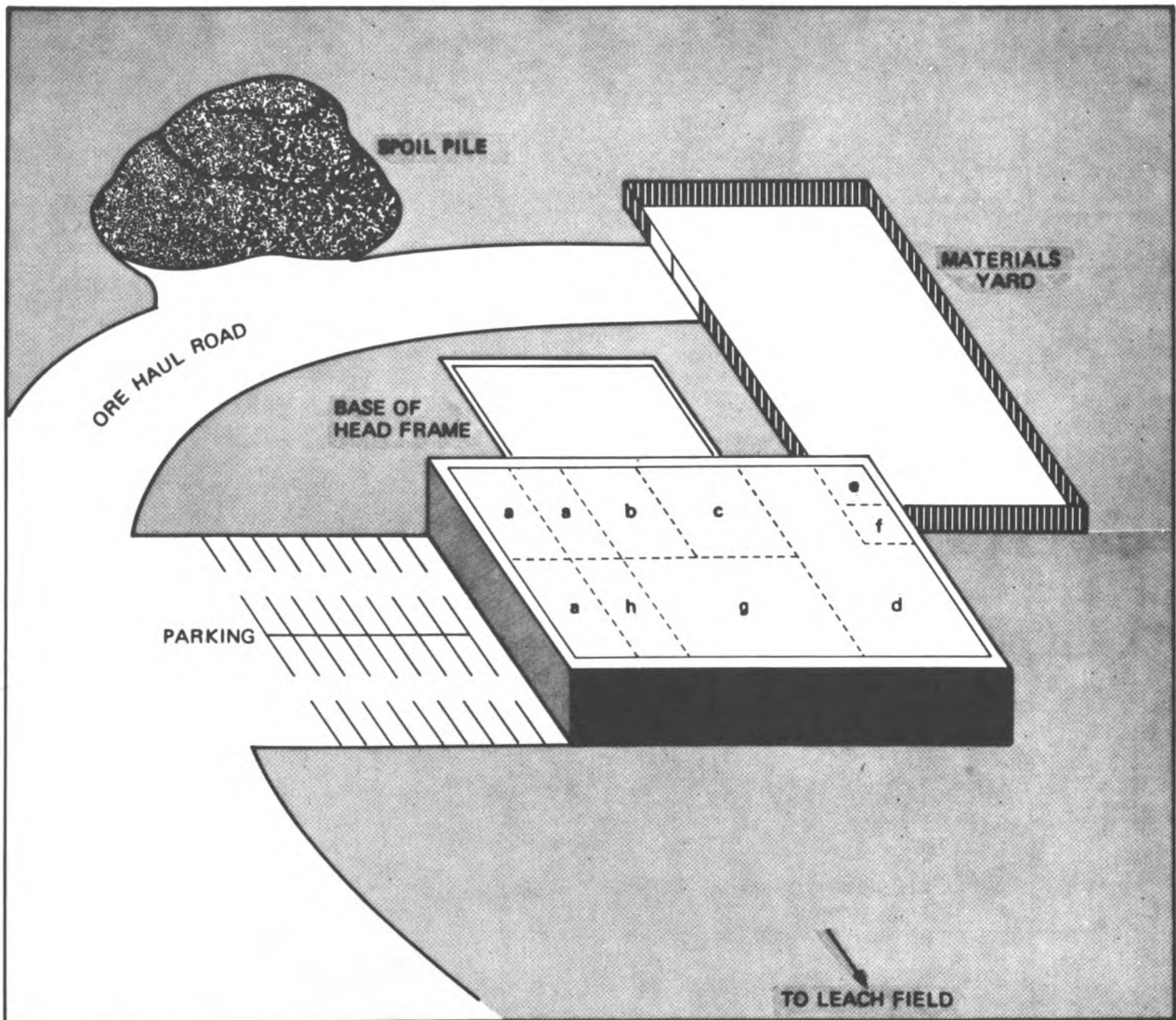
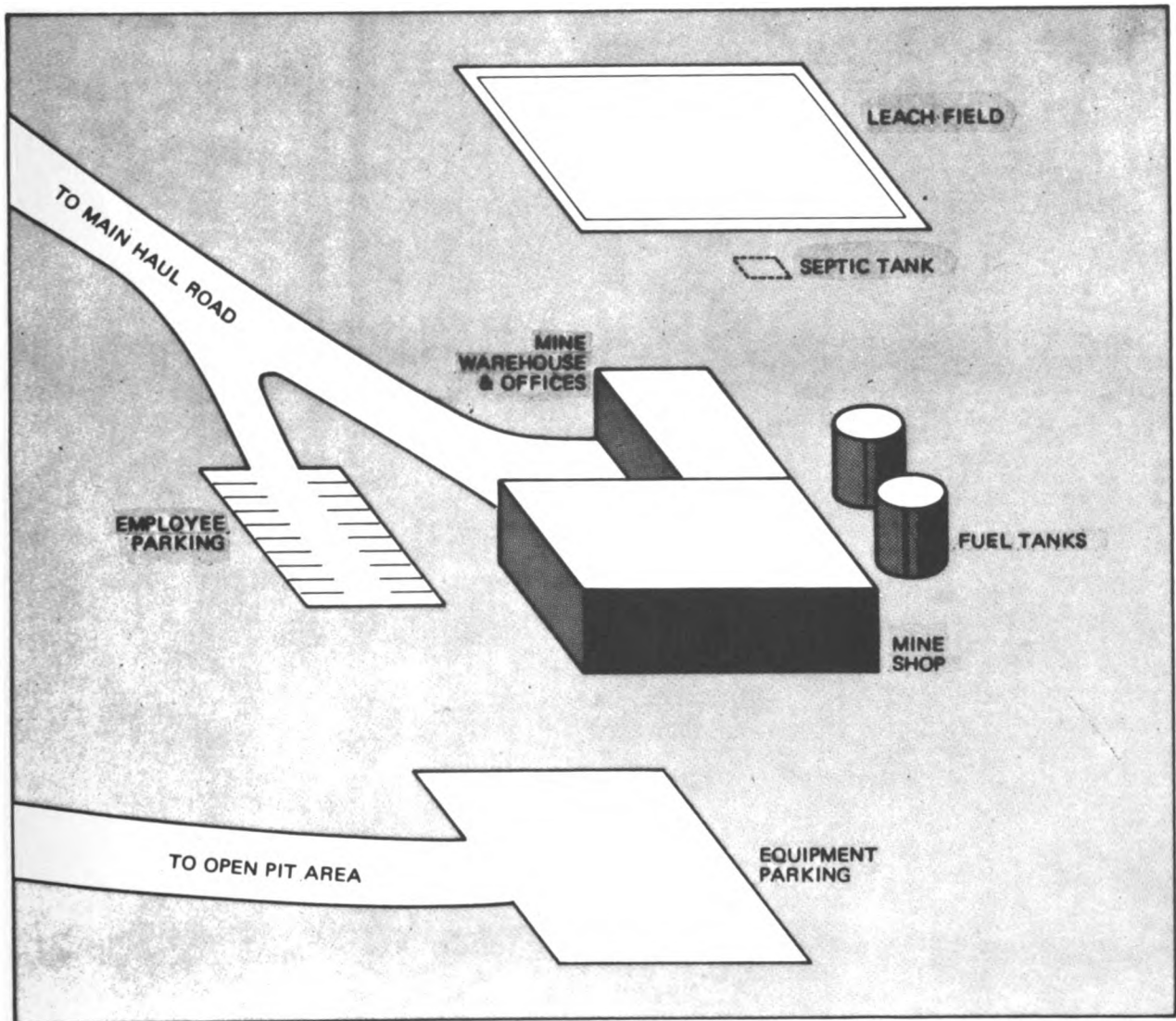


Figure 2.0-9 TENTATIVE LOCATION OF ROADS AND UTILITIES ON THE MORTON RANCH PROPERTY



- | | |
|-----------------|------------------------|
| a. MINE OFFICES | e. COMPRESSOR ROOM |
| b. HOIST ROOM | f. EMERGENCY POWER |
| c. SHOP | g. MEN'S CHANGE ROOM |
| d. WAREHOUSE | h. WOMEN'S CHANGE ROOM |

2.0-10 SURFACE SUPPORT FACILITIES FOR THE UNDERGROUND MINE



2.0-11 SURFACE SUPPORT FACILITIES FOR THE OPEN PIT MINES

3.0 EXISTING ENVIRONMENT

This section provides a basic description of the existing environment and the important characteristics and values of the Morton Ranch property as it now exists. This information establishes a basis for consideration of the environmental impact associated with implementing the proposed uranium mining project.

3.1 LAND USE

1. Past Regional Land Use - A small amount of precipitation and a lack of readily available water for irrigation makes much of eastern Wyoming unsuitable for raising crops. For this reason the principle agricultural use of the land has been livestock grazing.

During the 1870's and 1880's, Wyoming became one of the major beef-producing states in the country. By 1885 there were approximately 895,000 head of cattle in the state.¹ Pioneer cattlemen depended largely upon free use of government land to raise their herds. As late as 1890, at the time of statehood, only about 10 percent of Wyoming land was in private ownership.

By 1886 the rangeland of Wyoming had become severely overgrazed. Conditions in the severe winter of 1886-87 caused the death of fully half the cattle in the Powder River area and marked the end of the days of the huge cattle herds.

From 1900 to 1914, sheep ranching increased dramatically in the state. The 1900's also brought a period of intensive homesteading. However, much of the land in the state was too arid to make small-scale farming and ranching economically feasible and by the end of the 1930s' Depression, most of the homesteads had been abandoned.

Coal and oil were recognized and developed shortly after Wyoming became a state. Oil was discovered in the state near Salt Creek, just south of the town of Midwest, in the 1890's. By 1917 there were 23 proven fields, 475 producing wells, and 5 refineries.

By 1918 more than 9 million tons of coal were being produced from Wyoming mines annually. With the rapid conversion to diesel fuel by the railroads in the early 1950's, Wyoming lost much of its coal market.

Small uranium deposits were found near Lusk as early as 1918. In 1951 minable quantities of uranium were discovered at Pumpkin Buttes, approximately 70 miles north-northwest of the Morton Ranch. In 1953 the discovery of a rich uranium deposit in the Gas Hills of Fremont County (west of Converse County) caused a prospecting boom in the state.¹ Between 1957 and 1962 six uranium mills were built in Wyoming, with a total capacity of 3539 tons of ore per day. Wyoming became the second largest producer of uranium in the country, with more than half of the state's production coming from Fremont County.

2. Present Regional Land Use - Livestock grazing is presently the largest land use in Converse County (Table 3.1-1). Most ranchers raise both cattle and sheep on their land because it allows a more complete use of the available forage. The proportion of cattle to sheep varies from year to year depending largely on economic factors. As of January 1, 1974, Converse County supported 110,000 head of sheep and 76,500 head of cattle.² The crops raised in Converse County consist almost entirely of grain and hay (Table 3.1-2).

Energy extraction is another important land use in Converse County. The most significant energy resources of the county are uranium ore, oil, and coal. Most of these are located in the northern

two-thirds of the county. Coal mining and uranium mining and milling are being performed in Converse County at the present time.

Significant hunting occurs in Converse County, with approximately 12,271 hunters spending about 25,371 man-days hunting big game in 1973. In the same year, 4,927 pronghorn antelope (the most sought-after game) were harvested in the county. This represents approximately 13.3 percent of the total state harvest for that year.

Major towns in Converse County are Douglas and Glenrock. The settlement of Orpha (estimated population of 20) lies 15 miles south of the Morton Ranch property. The settlement of Bill (estimated population of 5) lies 20 miles northeast of the property.

3. Project Area - Sheep grazing constitutes the predominant land use within 5 miles of the Morton Ranch property. The project area receives only incidental recreation use. Although some big game species are found on the property, hunting is limited. There are no known existing or proposed recreation facilities within the project site boundaries. The project area has very low potential for intensive recreation use and development, and has no known unique scenic or natural features of recreational value. There are no active residences within the project site boundaries. Two nearby ranches - the Vollman Ranch (1 mile southwest of the southwest corner of the northern portion of the property) and the Fowler Ranch - (2 miles east of the northern portion of the property) raise livestock and grow a small amount of crops. Most of the Morton Ranch property is used for grazing livestock with an estimated 10,000 sheep and 3,000 cattle on the ranch's 250,000 acres.

Major transportation and utility corridors in the vicinity of the Morton Ranch property include Interstate 25 and State Route 59 (Douglas to Gillette), the Burlington Northern Railroad, and the Chicago and Northwestern Railroad (Figure 3.1-1). The McCulloch natural gas pipeline (16 in.) traverses Converse County from north to south, as does the majority of the Panhandle Eastern pipeline (16 in.). The Plains oil pipeline (8 in.) passes north of Douglas, running east-west. Major electrical transmission rights-of-way are Pacific Power and Light 230-kV and 69-kV lines running north from the Dave Johnston power plant and a 34.5-kV line running west from Bill.

Transportation facilities on or adjacent to the Morton Ranch property include the Highland Loop Road, Ross Road (south to Orpha), and Glenrock-Ross Road (southwest to Glenrock). Numerous unimproved roads crisscross the Morton Ranch area. A 69-kV transmission line parallels the western site boundary, and a 34.5-kV line traverses the site from northwest to southeast. The McCulloch 16-in. gas pipeline parallels the western boundary of the northern portion of the Morton Ranch property (Figure 3.1-1).

A uranium mine and mill are on property which adjoins the proposed project site (Figure 2.0-9).

4. Land Use Planning - There are no active land use planning commissions in Converse County. Land use regulations within the town of Douglas consist of an adopted zoning ordinance and annexation and

subdivision regulations. There is also a proposed ordinance regulating the development of mobile-home parks. The town of Glenrock has adopted a zoning ordinance to regulate and restrict the use of land. Converse County has no adopted land use regulations.

TABLE 3.1-1
LAND USE IN CONVERSE COUNTY, WYOMING

Land Use	Acres	Percent of Total Area
Cropland	60,340	2.1
Grazing	2,503,742	89.1
Forest and Woodland	207,068	7.4
Urban	37,595	1.4
Total*	2,808,745	100

*Land use statistics exceed the county acreage total of 2,729,129 because some grazing is allowed on forested lands.

TABLE 3.1-2
CROPS HARVESTED IN CONVERSE COUNTY, WYOMING (1973)

Crop	Irrigated Acres	Nonirrigated Acres
All Wheat	230	1950
Barley	1,400	950
Oats	1,500	700
Dry Beans	500	--
Sugar Beets	210	--
Corn	100	--
All Hay	<u>32,000</u>	<u>3600</u>
Total*	35,940	7200

*Total differs from cropland listed in Table 3.1-1 since not all cropland was in use in 1973.

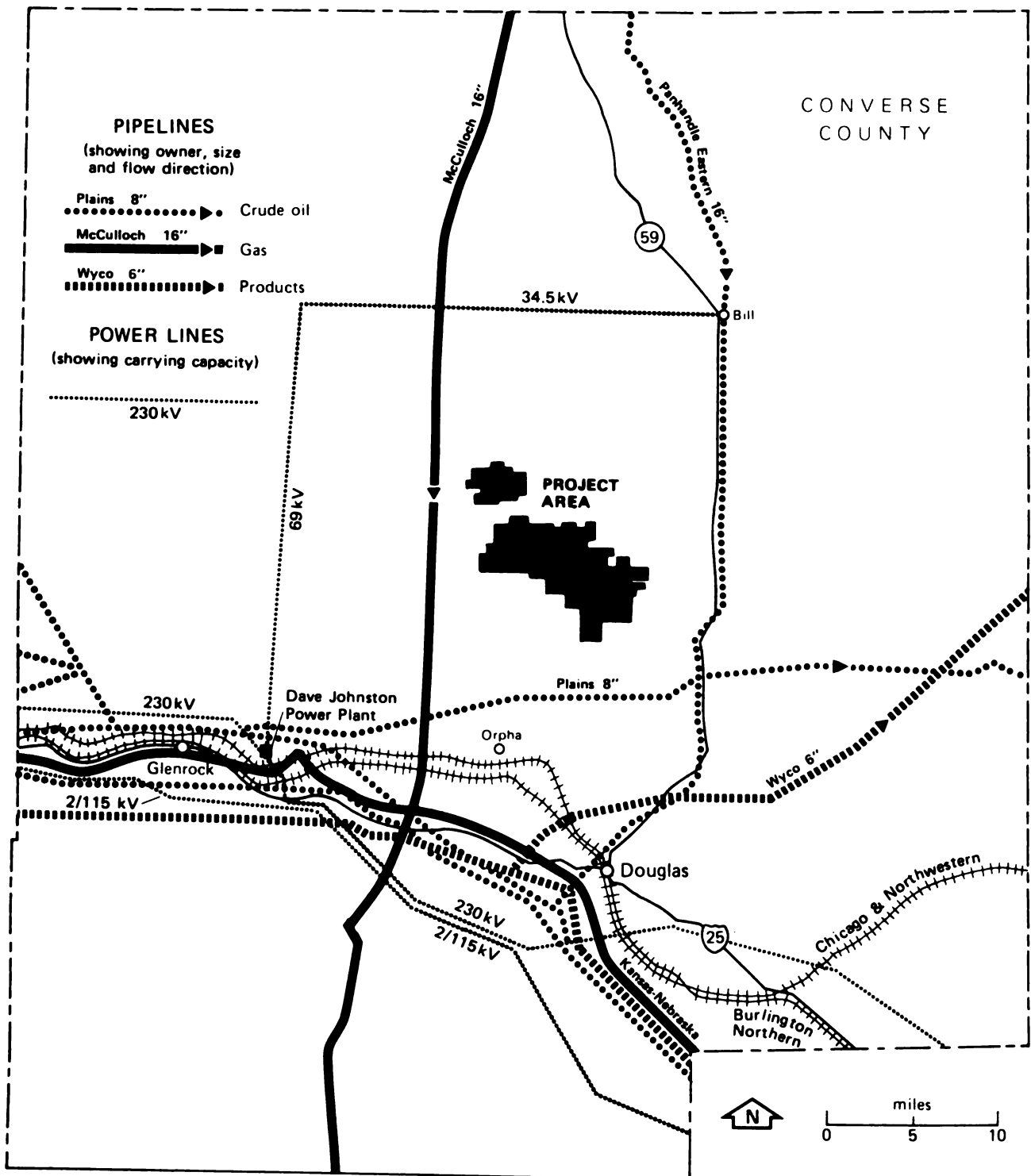


Figure 3.1-1 TRANSPORTATION CORRIDORS IN CONVERSE COUNTY

3.1 REFERENCES

1. Larson, T. A. 1965. History of Wyoming. Lincoln: University of Nebraska Press.
2. Wyoming Crop and Livestock Reporting Service. 1973. Wyoming agricultural statistics. Casper, Wyoming.

3.2 GEOLOGY

1. Regional Geology - The Morton Ranch uranium property is located near the southern margin of the Wyoming portion of the Powder River Basin^{1,2} (Figure 3.2-1). The Basin is a large structural and physiographic basin lying within the unglaciated Missouri Plateau Region of the Great Plains Physiographic Province.³ The Wyoming portion of the Powder River Basin encompasses an area of approximately 12,000 square miles and is bounded by the Black Hills uplift on the east; the Hartville uplift and the Laramie Mountains on the south and southeast; and the Big Horn Mountains to the west.

Structurally, the basin is asymmetrical with the axis oriented in a general north-south direction along the western margin of the basin. Sedimentary rock strata on the eastern flank dip gently to the west (approximately 1° or 2°). Along the western flank, the sediments dip steeply eastward (as much as 20°) toward the axis of the basin.

The Powder River Basin contains a sedimentary rock sequence with a maximum thickness of about 15,000 ft. along the basin axis. The sediments, ranging in age from Tertiary (3 to 70 million years old) to Cambrian (500 to 600 million years old), overlie a basement complex of Precambrian (600 million years old and older) igneous and metamorphic rocks.

The youngest rocks exposed in the Basin are erosional remnants of the Oligocene White River Formation preserved as the capping of the Pumpkin Buttes, approximately 70 miles north of the

proposed project site. The underlying Eocene Wasatch Formation occupies the central portion of the basin and is bounded by the peripheral outcrops of the successively older Tertiary and Cretaceous sediments along the flanks of the Basin. The most widely distributed rocks exposed within the basin are the Fort Union Formation of Paleocene Age and the Wasatch Formation of Eocene Age. Since the Wasatch and Fort Union Formations are the host rocks of the presently known uranium ore deposits on the Morton Ranch property, they will be given more detailed consideration here.

The Laramie uplift to the south was a major source of rock detritus for the Tertiary Age formations deposited in the subsiding Powder River Basin. Subsidence of the Powder River Basin was not continuous, nor did sedimentation occur at a constant rate. Sands and silts deposited during the Paleocene epoch suggest a fluvial environment of low-lying lands with relatively slow meandering streams that carried sediments basinward from the adjacent highlands.

The lower part of the Paleocene sequence, which is collectively termed the Fort Union Formation, is comprised mainly of weakly cemented quartzose, fine-grained silty sandstones and coal beds. Coal and an abundance of fine-grained sediments in the upper part of the formation suggest a slower rate of deposition in the basin during the latter part of the Paleocene epoch. The slower subsidence during that epoch created a swampy, poorly drained environment which was densely forested⁴. Near the close of the Paleocene epoch, the rate of subsidence of the basin and/or the rate of the uplift of the

adjacent highland accelerated. This tectonic change is reflected in some locations by a depositional disconformity between the Fort Union Formation and the overlying Wasatch Formation.

As uplift of the highlands continued into the Eocene Age (40 million to 60 million years ago), the Fort Union Formation was eroded at the margins of the basin and the material redeposited toward the center. The rapidly accumulating sediments of the Wasatch Formation were deposited increasingly farther out into the basin; correspondingly, the erosional disconformity between the Wasatch and the underlying Fort Union formations extended basinward and northward, along the axis of the basin.

Thin beds of decaying vegetation were laid down in back-water areas and were later metamorphosed into coal beds. Thick clastic sediments were deposited toward the center of the basin, with grain size decreasing as distance from the source area increased. The clastic constituents of the Wasatch Formation are increasingly coarse to the south, indicating the source of the sediments was in that direction. The mineralogy and the orientation of the bedding in the Wasatch Formation further support this conclusion and point to the Laramie Range as a major source of the material.

Another break in the sedimentary record occurred at the end of the Wasatch deposition. That break is evidenced by the disconformity between the Wasatch Formation and the overlying White River Formation of Oligocene Age.

2. Site Geology - The topography, structure, bedrock, and surficial materials of the site are discussed below.

Topography - Generally, the topography of the Morton Ranch site is characterized by gently rolling upland areas and broad stream valleys that are dissected by numerous draws with relatively steep slopes and rounded ridge crests (Figure 3.2-2). The upland areas, known locally as Taylor and Highland Flats, are remnants of a late-Tertiary-Age erosional surface.

The two portions of the Morton Ranch property (Figure 3.2-3) are drained mainly by the north and south forks of Box Creek (and their tributaries), which flow generally northeastward from their headwaters at the Box Creek topographic divide. This divide trends generally southeastward and coincides approximately with the southwestern boundary of the southern portion of the property. Cowell Creek drains the northwestern quarter of the northern portion of the property. All of these streams are ephemeral and occupy channels 200 to 400 feet below the upland areas.

Shallow depressions occur in the upland areas, ranging in size from 100 feet to approximately 500 ft. in diameter. These blow-out features appear to have been formed by wind erosion.

The topography between the upland areas and the stream valleys appear to be controlled primarily by the characteristics of the underlying bedrock. Generally, rolling topography forms over shales and claystones, while sharp breaks in slope are produced by the more erosion-resistant sandstones.

Lying northeast of the Box Creek divide, the Morton Ranch property slopes generally northeastward. The slope is severely complicated by geomorphically recent ravining. Maximum relief across the proposed project area is approximately 550 ft., with a maximum elevation of 5617 ft., atop Box Creek Divide, and a minimum elevation of 5060 at the point where the north fork of Box Creek crosses the property boundary.

Structure - The southern portion of the Morton Ranch property straddles a section of the structural axis of the Powder River Basin; thus within that portion of the property the strata of the Wasatch and Fort Union Formations are essentially flat-lying. As the northern portion of the property lies 3 to 10 miles east of that southeast-trending axis, the strata in that portion of the property dip generally 2 to 5 degrees northward.

No major faults or folds in the bedrock have been disclosed by exploration programs. A series of subparallel anticlines and synclines have been delineated to the north of the area. These structures have a maximum relief from 10 ft. to 20 ft. Such structures may be present on the Morton Ranch.

Bedrock - The Wasatch Formation is the uppermost bedrock unit throughout the proposed project site. The Wasatch Formation is known to be 1575 ft. thick in the Pumpkin Buttes area, approximately 70 miles north of the proposed project site. In the lease area, all but the basal 350 ft., has been eroded away.

The Wasatch Formation comprises fluvial sediments of interbedded and highly lenticular silty claystones, sandy siltstones, and relatively clean sandstones and claystones. The degree of lithification is variable, ranging from uncemented to moderately well-cemented sandstone, and from weakly consolidated and cemented claystones to fissile shales. For the most part, these beds are massively jointed.

The contact between the Wasatch Formation and the underlying Fort Union Formation lies about 12 miles west and a similar distance to the south and east of the Morton Ranch property. The generally arc-shaped contact evidences the structure of the south end of the basin. The contact cannot be located accurately on the basis of lithology because the Fort Union Formation has essentially the same lithologic characteristics as the Wasatch Formation in the southern part of the Powder River Basin. Figure 3.2-4 presents a cross-section of the Morton Ranch uranium property.

The Fort Union Formation in east-central Wyoming typically incorporates clays, siltstones, clayey sandstones, claystones, and coals. In the lease area, this Formation comprises fluvial (stream deposited), interbedded, highly lenticular silty claystones; sandy siltstones; relatively clean sandstones; arkosic sands; and claystones. A few thin limestones and coal seams less than 2 ft. thick occur locally within the formation. The degree of lithification is quite variable, ranging from virtually uncemented arkosic sands to moderately well-cemented siltstones and sandstones. The strata of the Fort Union

as well as the overlying Wasatch are highly lenticular with numerous facies changes within short distances. This makes it extremely difficult to trace individual stratigraphic units for any great distance.

Surficial Materials - The Wasatch Formation is mantled by a variety of surficial materials. They include residual soils that are formed in place from the weathering of underlying bedrock, and slopewash formed by the downslope movement of soils and weathered rock fragments. The residual soils and slopewash range in thickness from a few inches on the steep slopes to 10 ft. or more on the upland areas and on the lower valley slopes. The boundary between the surficial material and the bedrock is gradational.

The surficial materials generally range from sandy silt to clayey silt, but they may also grade from silty clay in the upland areas to clayey sand on the lower slopes. Sandy gravels, which appear to be residual in nature, cap ridge crests in the area. The gravels are probably derived from the weathering of the overlying conglomerates of the White River (a formation almost wholly eroded from the Powder River Basin) and Wasatch formations.

In addition to the residual soils, narrow bands of stream deposits underlie the floors of Cowell Draw and the north and south forks of Box Creek (Figure 3.2-3). That alluvium typically includes clays, silts, and sands with local gravel lenses. The material is unconsolidated and poorly stratified and is commonly 5 ft. to 15 ft. thick. Locally, the alluvium may be as much as 48 ft. thick.

Playa deposits, similar compositionally to the alluvium but more alkaline, occur in closed basins in the upland areas. Some wind-blown silts are present, but deposits of appreciable thickness do not occur in the area.

3. Ore Deposits - The uranium ore deposits on the lease area are typical geochemical cell or roll front type that occur in feldspathic to arkosic sandstone units. It is believed that this type deposit has been formed by deposition of uranium minerals from groundwater solutions at the contact or interface between oxidized and reduced subsurface environments.

In plan section, the individual deposits are elongated pods with the long dimension being 10 to 40 times the short dimension. The long axis is oriented parallel to the reduction-oxidation interface. In cross-section, the deposits have a generalized "C" shape with the open portion of the "C" on the oxidized side of the reduction oxidation contact. The uranium minerals are precipitated from the groundwater in the reducing environment. To date, three uranium minerals: coffinite, zippeite, and liebigite have been identified through analysis of rock core samples. They occur primarily as coatings on the individual grains which comprise the sandstone host rocks. In this type of uranium mineral deposition, it is believed that parts of the present known deposits have migrated within the sandstone units in conjunction with the down dip movement of the reduction oxidation contact.

4. Geotechnical Considerations - East-central Wyoming is not considered to be a seismically active area, although it has been

shaken periodically by earthquake-induced ground tremors. Tremors recorded in the region, however, have been almost universally mild, with damage reportedly slight and confined to localized areas (Figure 3.2-5).

Of the major earthquakes recorded, the closest to the proposed project site occurred near Hebgen Lake, Montana, August 17, 1959. The epicenter of that earthquake was approximately 290 miles northwest of the proposed project site and had a maximum intensity, based on vibrational effects (excluding landslides and fault movement) of VIII (Modified Mercalli scale). Between 1853 and 1973 no regionally disastrous earthquakes were recorded within 200 miles of the proposed project site. Table 3.2-1 lists the probably intensities and maximum ground accelerations at the proposed project site associated with several earthquakes dating back to 1928. As shown, the intensities at the proposed project site associated with these earthquakes could be expected to range between III and VI, with associated maximum ground accelerations up to .015g.

TABLE 3.2-1

MAXIMUM EXPECTED EARTHQUAKE INTENSITIES AND GROUND
ACCELERATIONS AT THE PROPOSED MORTON RANCH PROJECT SITE

Earthquake Location	Maximum Epicentral Intensity on Record*	Distance from Epicenter to Proposed Project Site	Maximum Probable Intensity at Proposed Project Site*	Maximum Ground Acceleration at Proposed Project Site
Hebgen Lake, Montana (1959)	IX-X	300 mi	III	< 0.01g
Northeastern Nebraska (1964)	VII	200 mi	IV	.015g
Black Hills, South Dakota (1928)	V	100 mi	III	< 0.01g

*Modified Mercalli Scale

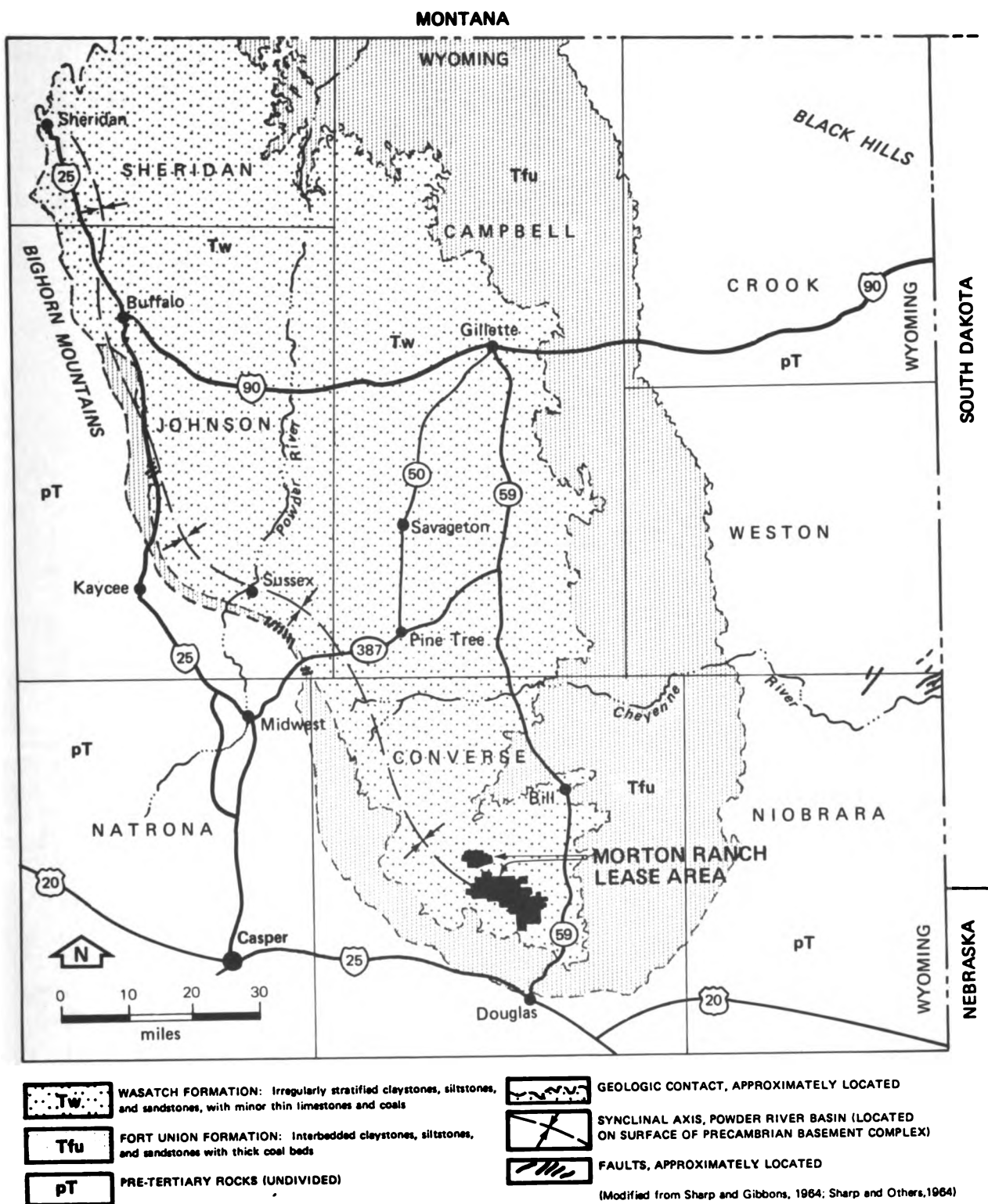


Figure 3.2-1. REGIONAL GEOLOGY

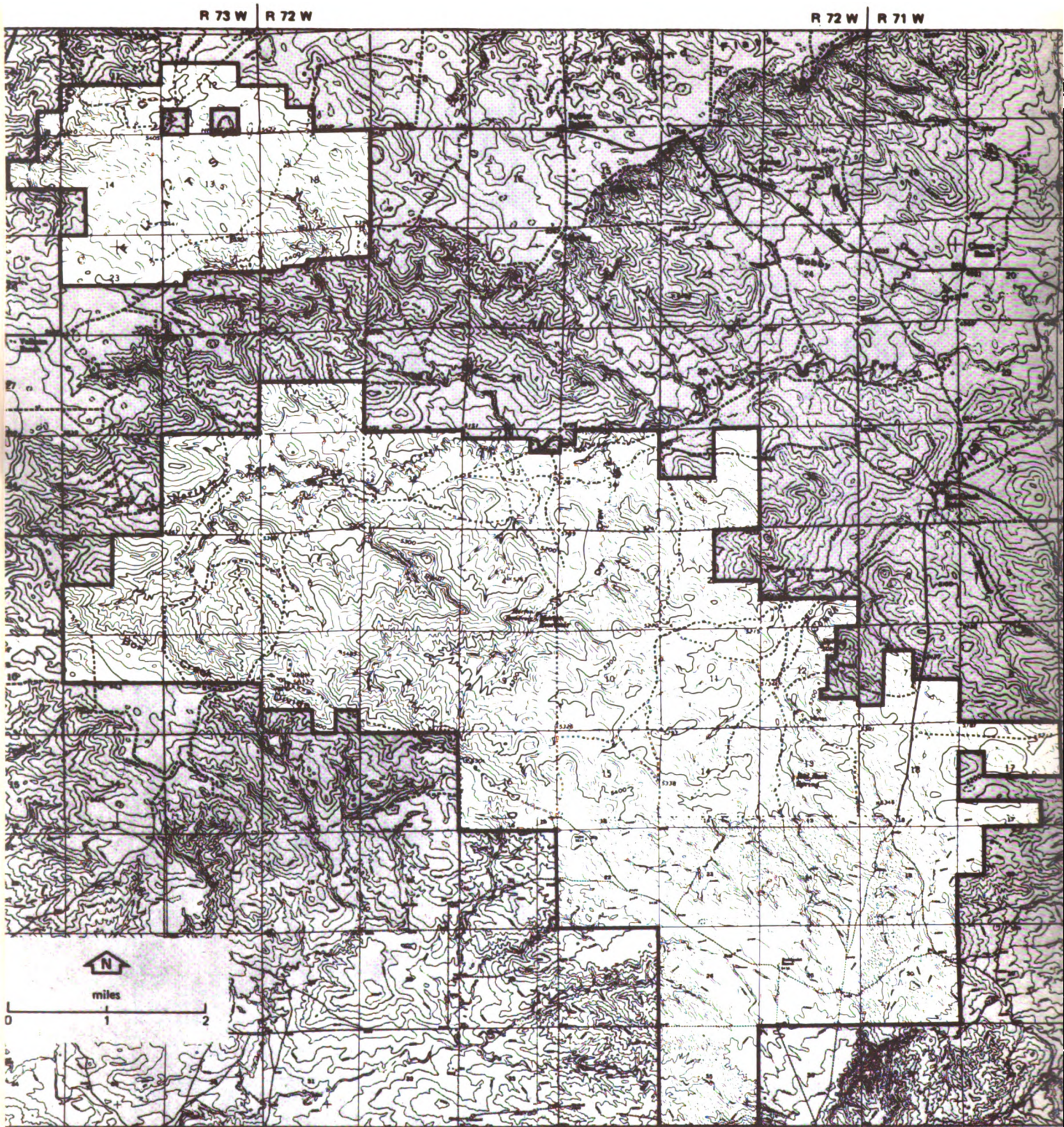
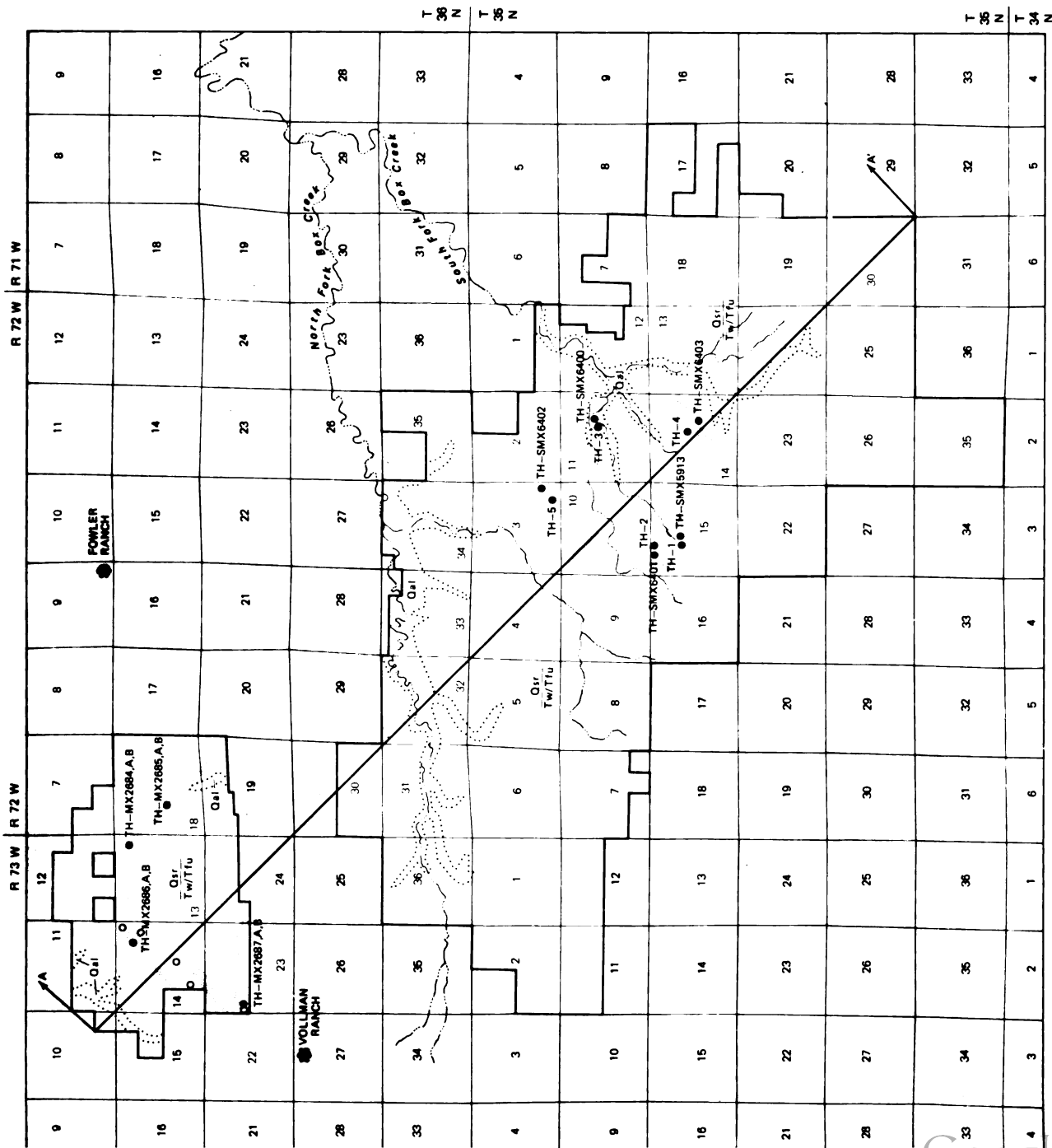


Figure 3.2-2
TOPOGRAPHY OF THE MORTON RANCH PROPERTY



3.2 REFERENCES

1. Strickland, J., et al. 1958. Powder River Basin. Wyoming Geological Association, 13th Annual Field Conference.
2. Love, J. D., and J. L. Weitz. 1951. Geologic map of the Powder River Basin and adjacent areas, Wyoming. U. S. Geological Survey Oil and Gas Investigation Map OM-122.
3. Thornbury, W. D. 1969. Principles of Geomorphology. New York: John Wiley & Sons, Inc.
4. Sharp, W., and A. G. Gibbons. 1964. Geology and uranium deposits of the southern part of the Powder River Basin, Wyoming. U. S. Geological Survey Bulletin 1147-D.
5. Langen, R. E., and A. L. Kidwell. 1974. Geology and geochemistry of the Highland uranium deposit, Converse County, Wyoming. Mountain Geologist Vol. 11 No. 2:84-93.

3.3 SOILS

The soils of the Morton Ranch property have developed from sedimentary bedrock, and are generally thin, except where alluvial or colluvial deposits exist. All horizons* of the soils are usually found to be neutral or slightly alkaline in pH. A calcium carbonate accumulation usually occurs in the upper C horizon* and in general, soluble salt constituents are found to have accumulated in the lower horizons. The soils are normally low in organic content and nitrogen, however, as determined by the U.S. Soil Conservation Service in a survey of the proposed project site, when combined with sufficient moisture, the soils are adequate in both quantity and quality to support revegetation of all areas that would be affected by the proposed mining. Figure 3.3-1 and 3.3-2 provide soil maps of the project area. Complete soil series descriptions are on file at the U.S. Soil Conservation Service office in Douglas, Wyoming.

Soils associations, (presented in Table 3.3-1), have been grouped for topsoil suitability based on general texture, structure, erodability, water-holding capacity, soluble salts content, and depth. A soil interpretation chart is provided in Table 3.3-2.

*See footnotes to table 3.3-2 for definitions of the A, B, and C horizons.

Table 3.3-1
SOILS ASSOCIATIONS

Map Code	Association or Complex	Topography	Topsoil Suitability*
151 DE	Shingle-Rock outcrop	10-60% slope	7
158 AB	Kim-Stoneham	undulating	1
179 AB	Ulm-Renohill	undulating	2
212 B	Cushman-Stoneham	gently sloping	2
212 CD	Cushman-Stoneham	rolling	2
321 AB	Cushman-Renohill	0-6% slope	3
321 B	Cushman-Renohill	3-6% slope	5
321 C	Cushman-Renohill	6-10% slope	5
321 CD	Cushman-Renohill	rolling	5
329 CD	Thedalund-Terry-Renohill	rolling	6
331 AB	Fort Collins-Ulm	undulating	1
332 B	Cushman-Terry	gently sloping	3
334 AB	Ulm-Bidman	undulating	5
335 CD	Renohill-shingle	rolling	7
338 B	Briggsdale-Pugsley	gently sloping	5
338 CD	Briggsdale-Pugsley	rolling	5
339 CD	Renohill-Olney	rolling	6
340 AB	Absted-Bone	0-6% slope	7
342 CD	Cushman-Pugsley	rolling	3
343 B	Briggsdale-Cushman	rolling	3
343 CD	Briggsdale-Cushman	rolling	6
348 D	Shingle-Thedalund-Stoneman	moderately steep	5
353 AB	Undifferentiated alluvium	undulating	4
354 AB	Ulm-Bidman	undulating	5
365 AB	Bidman-Briggsdale	undulating	6
402 CD	Shingle-Tassel	rolling	6
403 AB	Ulm-Cushman	undulating	2
404 CD	Ulm-Pugsley	rolling	2
405 CD	Ulm-Renohill	rolling	5

* The general description of each category is as follows:

1. Good topsoil suitability to a 60-inch depth
2. Good topsoil suitability to 60 inches or bedrock; bedrock depth range from 24 inches to 30 inches.
3. Good topsoil suitability to bedrock; bedrock depth range from 24 inches to 30 inches.
4. Good topsoil suitability; undifferentiated alluvium.
5. Good to fair topsoil suitability to 60 inches or bedrock; bedrock depth range from 15 inches to 40 inches.
6. Fair topsoil suitability to 60 inches or bedrock; bedrock depth range from 15 inches to 40 inches.
7. Poor topsoil suitability.

Table 3.3-2

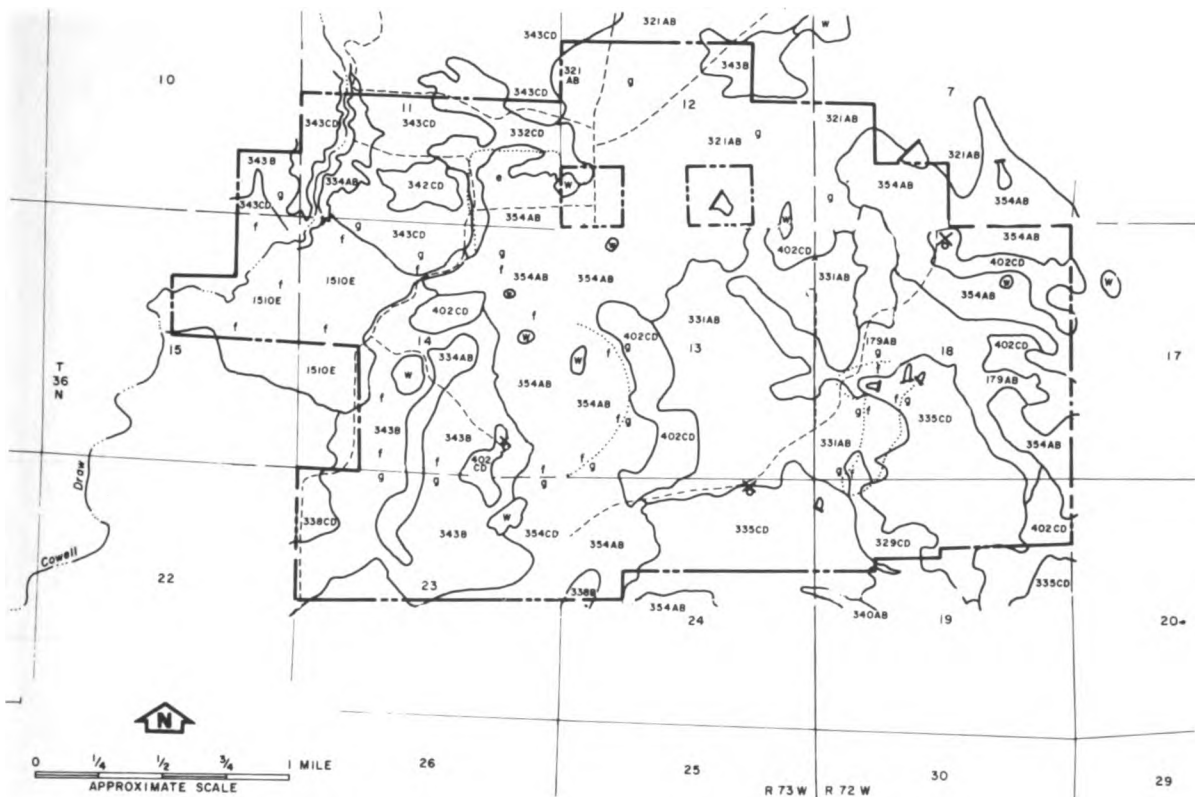
SOIL INTERPRETATION CHART

Series	Texture	Depth in Inches			Suitability For Use in Topsoiling	Remarks
		A Horizon ¹	B Horizon ²	C Horizon ³		
Absted	Very fine sandy loam	0-3	3-12	12-60	Good	
Bidman	Loam	0-5	5-26	26-60	Good	
Bone	Silty Clay	0-1	1-12	12-65	Poor	Clay Material, High pH
Briggsdale	Loam	0-5	5-26	26-32	Good	
Cushman	Loam	0-2	2-12	12-30	Good	
Ft. Collins	Loam	0-5	5-24	24-60	Good	
Haverson	Loam	0-6	-	6-60	Good	
Kim	Loam	0-14	-	14-60	Good	
Lohmiller	Clay Loam	0-8	-	8-60	Fair	Clay Material
Olney	Loamy Sand	0-5	5-22	22-60	Fair	Sandy Material
Pugsley	Sandy Loam	0-4	4-24	-	Good	
Renohill	Clay Loam	0-4	4-20	20-40	Fair	Clay Material
Shingle	Clay Loam	0-8	-	8-15	Fair	Clay Material
Stoneham	Loam	0-4	4-12	12-60	Good	
Tassel	Fine Sandy Loam	0-8	-	8-20	Good	
Terry	Fine Sandy Loam	0-5	5-18	18-26	Good	
Thedalund	Clay Loam	0-8	-	8-30	Fair	Clay Material
Ulm	Loam	0-5	5-26	26-60	Good	

¹A Horizon - The portion of the soil profile darkened with organic material and the best part of the soil for topsoiling.

²B Horizon - Layer of altered material underlying A horizon has less organic material biological activity.

³C Horizon - Layer of unconsolidated material, little affected by the influence of organisms.



Source: U.S. Soil Conservation Service

LEGEND

402CD	SOIL MAPPING UNIT SYMBOL WITHIN APPROXIMATE BOUNDARY OF UNIT MAPPED.
f	SOIL RANGE CONDITION CLASSIFICATION WITHIN APPROXIMATE BOUNDARY OF UNIT MAPPED. SEE LEGEND FOR RANGE CONDITION.
Δ	SHALL DAM AND RESERVOIR
W	INTERMITTENT STANDING WATER
✕	WINDMILL
○	SPRING
---	PROPERTY LINE
---	UNIMPROVED DIRT ROAD

LEGEND FOR RANGE CONDITION

RANGE CONDITION IS THE PRESENT STAGE OF VEGETATION IN RELATION TO CLIMAX CONDITION FOR THAT RANGE SITE. RANGE CONDITION PROVIDES AN APPROXIMATE MEASURE OF ANY DETEIORATION THAT HAS TAKEN PLACE IN PLANT COVER AND SERVES AS A BASIS FOR PREDICTING THE DEGREE OF IMPROVEMENT POSSIBLE.

MAP SYMBOL	RANGE CONDITION CLASS	PERCENT OF PRESENT COMPOSITION THAT IS POTENTIAL FOR THE RANGE SITE
o	EXCELLENT CONDITION	76-100
g	GOOD CONDITION	51-75
f	FAIR CONDITION	26-50
p	POOR CONDITION	0-25

RANGE CONDITION CLASSES, WITHIN THE SAME RANGE SITE, ARE SEPARATED BY A DOTTED LINE.

MAP SYMBOL	PERCENT SLOPE	NAME OF SOIL ASSOCIATION	RANGE SITE
1510E	10-60%	SHINGLE ROCK OUTCROP COMPLEX	SHALLOW CLAYEY
156AB	0-5%	KIM-STONENAM	LOAMY
179AB	0-5%	ULM-RENOHILL	LOAMY-CLAYEY
212B	3-5%	CUSHMAN-STONENAM	LOAMY
212CD	6-15%	CUSHMAN-STONENAM	LOAMY
321AB	0-6%	CUSHMAN-RENOHILL	LOAMY-CLAYEY
321B	3-6%	CUSHMAN-RENOHILL	LOAMY-CLAYEY
321C	6-10%	CUSHMAN-RENOHILL	LOAMY-CLAYEY
321CD	6-15%	CUSHMAN-RENOHILL	LOAMY-CLAYEY
329CD	6-15%	THEDALUND-TERRY-RENOHILL	LOAMY-SANDY-CLAYEY
331AB	0-5%	FORT COLLINS-ULM	LOAMY
332B	3-5%	CUSHMAN-TERRY	LOAMY-SANDY
334AB	0-5%	ULM-BIDMAN	LOAMY
335CD	6-15%	RENOHILL-SHINGLE	CLAYEY-LOAMY-SHALLOW CLAYEY
338B	3-5%	BRIGGSDALE-PUGSLEY	SHALLOW CLAYEY-SHALLOW SANDY
338CD	6-15%	BRIGGSDALE-PUGSLEY	SHALLOW CLAYEY-SHALLOW SANDY
339CD	6-15%	RENOHILL-OLNEY	SHALLOW CLAYEY-SHALLOW SANDY
340AB	0-5%	ABSTED-BONE	PAN SPOTS-SANDY
342CD	6-15%	CUSHMAN-PUGSLEY	LOAMY-SANDY
343B	3-6%	BRIGGSDALE-CUSHMAN	LOAMY
343CD	6-15%	BRIGGSDALE-CUSHMAN	LOAMY
348D	9-15%	SHINGLE-THEDALUND-STONENAM	SHALLOW CLAYEY-LOAMY
353AB	0-5%	UNDIFFERENTIATED ALLUVIUM	LOAMY
354AB	0-5%	ULM-BIDMAN	LOAMY
365AB	0-5%	BIDMAN-BRIGGSDALE	LOAMY
402CD	6-15%	SHINGLE-TASSEL	SANDY-SHALLOW CLAYEY
403AB	0-5%	ULM-BOX CREEK-CUSHMAN	LOAMY
404CD	6-15%	ULM-BOX CREEK-PUGSLEY	LOAMY-SANDY
405CD	6-15%	ULM-BOX CREEK-RENOHILL	LOAMY-CLAYEY

Figure 3.3-1 SOILS MAP FOR THE MORTON RANCH PROPERTY (northern portion)

3.4 HYDROLOGY AND WATER QUALITY

1. Surface Water Hydrology - Streams draining the Morton properties are described in the section on Site Geology, subsection Topography, page 3.2-4. Their locations are shown in Figure 3.2-3, and locations with respect to mining operations are shown in Figure 2.0-7. The principal streams draining the project site are the North and South Forks of Box Creek, intermittent streams which flow easterly through the site and eventually flow into the Cheyenne River via Lance Creek. (See Figure 3.4-1).

The Morton Ranch property is located in a semiarid region of Wyoming. Average annual precipitation is about 12 inches per year, approximately 30 percent of which falls during May and June.

Average annual runoff from the Morton Ranch property, based on records from gaged watersheds in the vicinity ranges from 0.3 to 0.5 inches. Part of it comes from snowmelt, but during long periods, the streams are dry. High-peak flows are mostly the result of runoff from convective-type storms which approach from the west. Records from small gaged watersheds in the vicinity of the property indicate that one or two such runoff events can be expected each year during the summer.

The magnitude of these runoff events was estimated by a hydrological investigation conducted on the upper reaches of the North and South Forks of Box Creek by the Soil Conservation Service. The reasonable upper limits of peak discharge rates, defined by the 6-hour storms with a 100-year return period (3.1 inches), ranged from 200 ft.³/sec. to 600 ft.³/sec. per square mile.

2. Groundwater Hydrology - The stratigraphic units applicable to the groundwater geology of the lease area include Holocene alluvial deposits, the Eocene Wasatch Formation, and the Paleocene Fort Union Formation.

Alluvium - The Holocene alluvium located in the valleys of Cowell Draw and along the north and south forks of Box Creek, consists of unconsolidated, poorly stratified clays, silts, and sands with local gravel lenses and is estimated to be as much as 40 feet thick. Since no wells are located in the alluvium in the lease area, little subsurface information is available. Some underflow is present in Box Creek during part of the year, as evidenced by small ephemeral ponds. Based upon the levels at which water was encountered in the bedrock drill holes, the alluvial water is probably perched on clayey zones of bedrock, and the alluvial aquifers are presumably losing streams. The potential for the development of alluvial groundwater supplies is not promising, except for livestock supply on an intermittent basis since more reliable water is generally available from shallow aquifers.

Wasatch and Fort Union Formations - The two formations are typically lenticular, fine to coarse-grained, relatively clean sandstones and arkosic sandstones with interbedded claystones and siltstones. The Wasatch Formation is approximately 350 feet thick and the Fort Union Formation may be as thick as 3000 feet.

Because of the lenticularity of its aquifers, the Wasatch Formation is considered to be of minor importance as a source of groundwater on the Morton Ranch property. The Fort Union Formation, however, is capable of yielding significant amounts of water in that part of

the Powder River Basin.¹ Wells that tap the Fort Union sandstones in the lease area have yields ranging from 20 gal./min. to 150 gal./min.

Deeper Aquifers - The Lance Formation, which underlies the Fort Union at a depth of about 3000 feet, is between 2500 and 3000 feet thick in the vicinity of the property. It comprises fine to medium-grained sandstones and interbedded sandy shales and claystones. Yields from water wells in the Lance Formation are generally small and of poor quality.³ The formation would not normally be tapped for a water supply and is not expected to be affected by the proposed mining.

The underlying Fox Hills Formation is used for municipal and domestic water in areas where no suitable water is available from shallower sources. It is unlikely that this formation will be tapped for a water supply in the Morton Ranch area in the foreseeable future because it lies at a depth (5500 feet to 6000 feet) greatly in excess of normal water-well drilling depths. Because of that extreme depth, the Fox Hills Formation would not be disturbed by the mining operation.

Groundwater Use - Wells on the Morton Ranch property are widely scattered and are used primarily for watering livestock, and to a lesser extent for domestic purposes (Figure 3.4-2). About 20 wells are located within the property and 111 are located within 6 miles of the property boundary. Of these, 16 are dewatering wells located on the adjoining mining property. These reportedly yield approximately 40 gal./min. each, or in aggregate, about 640 gal./min.

Groundwater at Open Pit Area - Ten water monitor/sampling test holes were drilled down to and through the prospective ore zone

in five planned open-pit areas in the southern portion of the Morton Ranch property (Figure 3.2-3). Two-inch plastic pipe piezometers were installed in each hole. The holes were drilled in pairs, with one being drilled in the proposed ore body and its partner hole being drilled adjacent to but outside the prospective ore body. The test holes were drilled to provide hydrogeologic data on the aquifers encountered, as well as to serve as monitoring stations during and after mining operations.

Groundwater was first encountered at approximately the same geologic horizon in all test holes (Figure 3.4-3). Measurements of the water levels taken after the wells were completed showed the free-standing water levels generally to be significantly (30 to 80 ft.) above the level at which the water-bearing unit was initially encountered, thus suggesting that the aquifers in the southern portion of the lease area apparently are confined and under artesian pressure.

The ore sand is the uppermost aquifer in the proposed open pit mine area. The sand and sandstone units lying stratigraphically above the ore zone contain insignificant amounts of water.

Groundwater at Underground Mining Area - Two major aquifer systems were delineated by the data from test holes drilled in October and December, 1974, and from test holes drilled for dewatering and geotechnical studies on the northern portion of the property.³ Figure 3.4-2 shows the location of the test holes drilled in late 1974. Figure 3.4-4⁴ shows the location of the test holes and wells drilled for the dewatering study. Test holes were drilled through the ore

zone to determine the lithology and aquifer units; and were fitted with piezometers to isolate the lower, or ore zone, aquifers. Subsequent holes were drilled to selectively isolate the upper aquifer. The wells were pump-tested to determine hydrologic characteristics.

Water levels measured indicate that the aquifers are confined and are under artesian pressure, as evidenced by water levels 180 to 320 ft. above the aquifer units (Figure 3.4-5).

Data from the test holes drilled in the southern portion of the property indicate a northerly groundwater gradient (Figure 3.4-6) representing a regional gradient toward the center of the basin. Groundwater levels in the northern portion of the property generally indicate a gradient established by dewatering operations at the nearby mine. Groundwater movement within the lease area is slow because of the relatively low hydraulic gradient.

3. Water Quality - The quantities of various elements and compounds in natural waters depend on such factors as temperature, pH, and flow rate of the water, the composition and surface area of the rock and soil it contacts, and the duration of contact.

The following description of existing surface- and groundwater quality of the Morton Ranch property is based primarily on a field program conducted during October and December, 1974 and on historical records.^{2,4,5}

Groundwater Quality - The water quality of samples collected in the Wasatch and Fort Union formations (see Figure 3.4-7) appears

to correlate directly with permeability and distance from the recharge area. The occurrence of major ionic chemical components (Ca^{++} , Mg^{++} , Na^+ , HCO_3^- , Cl^- , $\text{SO}_4^{=}$) and of trace elements (including heavy metals) is primarily contingent on the chemical composition of the water-bearing materials.²

Tables 3.4-1 and 3.9-4 present the respective summaries of nonradiological and radiological groundwater analyses. Element distributions, as presented, show considerable variability due to clay material lensing in the sandy units which act as barriers to groundwater movement and preferentially concentrate some elements. A brief summary of the analyses are as follows:

- Analyses for Hg showed levels on the order of 0.1 ppb but with one sample as high as 0.7 ppb.
- Iron concentrations greater than 1 ppm were found in most groundwater samples (the U.S. Public Health Service (U.S.P.H.S.) recommends that iron concentrations in drinking water should be no higher than 0.3 ppm).
- Some of the groundwater samples had relatively high concentrations of uranium (range from 1.5 ppb to about 50 ppm) the latter of which exceeded the recommended U.S.P.H.S. drinking water standard of 5 mg/l (approximately 5 ppm).
- Four samples had concentrations of radium-226 that exceeded the U.S.P.H.S. drinking water standard of 3 pCi/l, however, all samples were well below the MPC (30 pCi/l) for release of radium-226 into the water in unrestricted areas.
- Thorium-230 values are well below MPC (2000 pCi/l) for release into water in unrestricted areas.

Surface Water Quality - The main drainage system of the Morton Ranch property consists of four intermittent creeks: Cowell Draw, at the underground mine site; the north and south forks of Box

Creek; and Lightning Creek at the surface mining area (Figure 2.0-2). Most of the water samples represent local seepage, in the form of springs, from the Wasatch Formation. Table 3.4-2 presents the site surface water analysis summary.

With the exception of a stagnant spring (test site TVA-13) located in the south fork of Box Creek below an old mine, iron concentrations in the surface water are less than 3 ppm, and in most cases less than 0.3 ppm (Figures 3.4-8 through 3.4-10).

Uranium, radium-226, and thorium-230 activities are presented in Table 3.9-4. Surface water radium-226 and thorium-230 activities were found to be well below the MPC for release into water in unrestricted areas.

Table 3.4-1

SUMMARY OF SAMPLING AND FIELD ANALYSES OF GROUNDWATER, MORTON RANCH PROPERTY

Location	Sample Number	Date	Source	Field Analyses					Laboratory Analyses Performance ^a
				Temp. (°C)	pH	NO ₃ (ppm)	Specific Conductance (umhos/cm)	Alkalinity (as CaCO ₃)	
Proposed Open Pit Mining Sites	TVA-9A	10/74 ^b	Windmill	11	7.3	98	360	--	R,U,AA
	TVA-9B	10/74	Cattle tank, fed from windmill	9	7.9	98	385	--	R,U,AA
	TVA-11	10/74	Pumping well	12	7.4	130	430	--	SS
	TVA-14 ^c	10/74	Observation well (NX-6401)	13	7.6	158	2000	--	R,U
	TVA-15	10/74	Windmill	13	7.5	98	285	--	R,U
	TVA-16 ^c	10/74	Observation well (NX-6403)	12	7.3	150	2200	--	R
	TVA-17	10/74	Windmill	19	8.0	73	760	--	SS
	TVA-20	10/74	Windmill	13	7.9	121	775	--	R,U
				Total Depth To Well (ft)	Depth to Water (ft)	Production Zone (ft)			
				260	147	171-253	340	305	15.2 R,U,AA
Proposed Underground Mining Site	NX-6401 (TVA-14)	12/74 ^d		9	8.3	--			
	NX-6402	12/74		10	8.4	--	675	154	22.7 R,U,AA
	NX-6403 (TVA-16)	12/74		10	--	--	260	223	22.7 R,U,AA
	TII-2	12/74		9	7.9	--	360	205	15.2 R,U,AA
	TII-4	12/74		9	7.4	--	260	171	11.4 R,U,AA
	TII-5	12/74		10	8.5	--	420	222	15.2 R,U,AA
	TVA-11	12/74	Resample of October 18-20 sampling program	--	--	--	--	--	R
	NX2685A	12/74		10	8.2	--	1200	205	15.2 R,U,AA
	NX2685B	12/74		11.5	8.5	--	410	154	22.7 R,U,AA
	NX2685	12/74		11	8.3	--	625	154	15.2 R,U,AA
Proposed Underground Mining Site	NX2686A	12/74		10	8.1	--	710	240	30.3 R,U,AA
	NX2686B	12/74		10.5	8.3	--	322	188	22.7 R,U,AA
	NX2686	12/74		11	7.8	--	510	137	15.2 R,U,AA

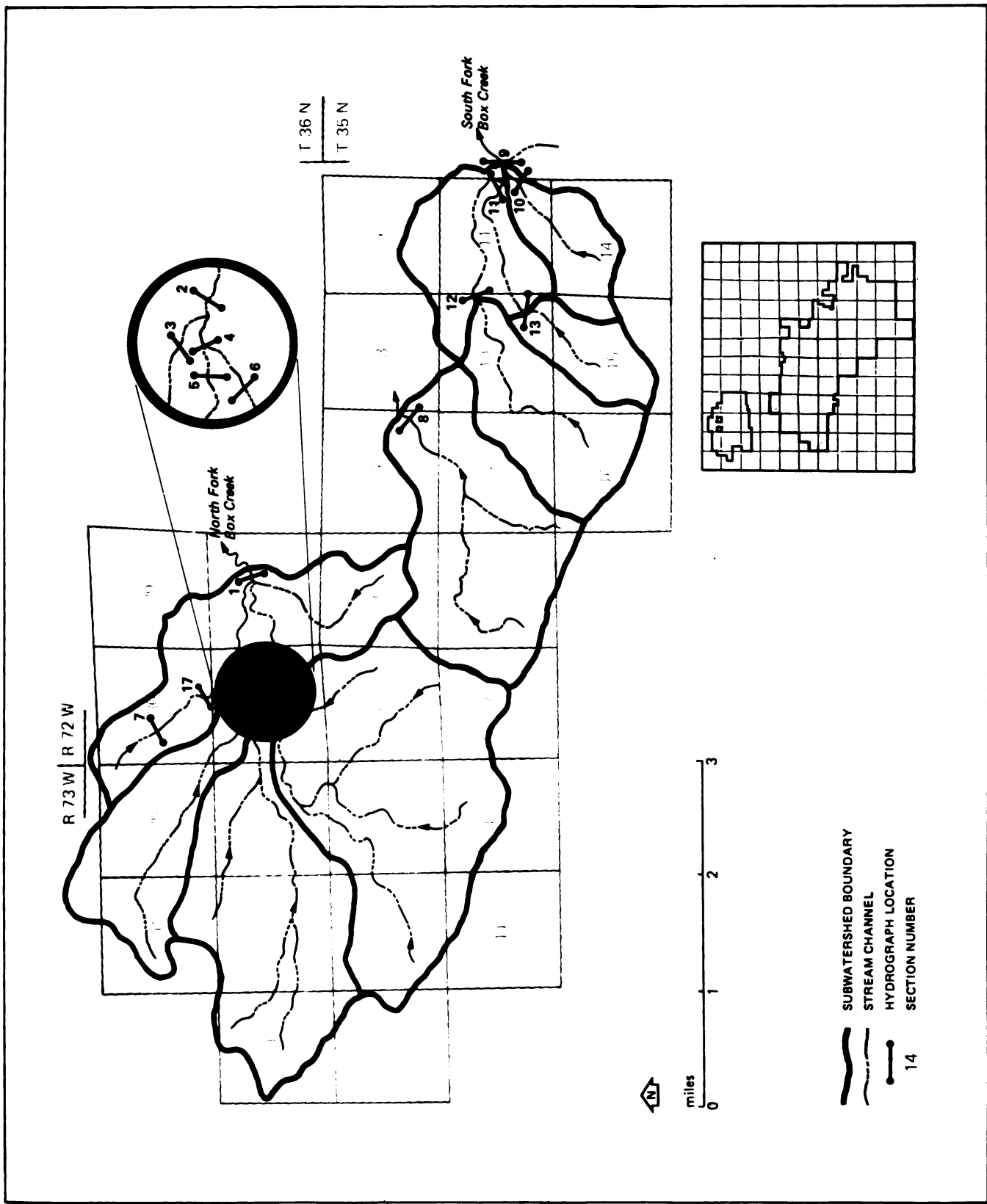
^a Legend: R=radioactive; U=uranium; SS=spark source; A=atomic absorption, selected trace elements.^b October sampling was done October 18-20, 1974.^c Sample contaminated with drilling mud.^d Duplicate sampling was done December 18-21, 1974.

Table 3.4-2

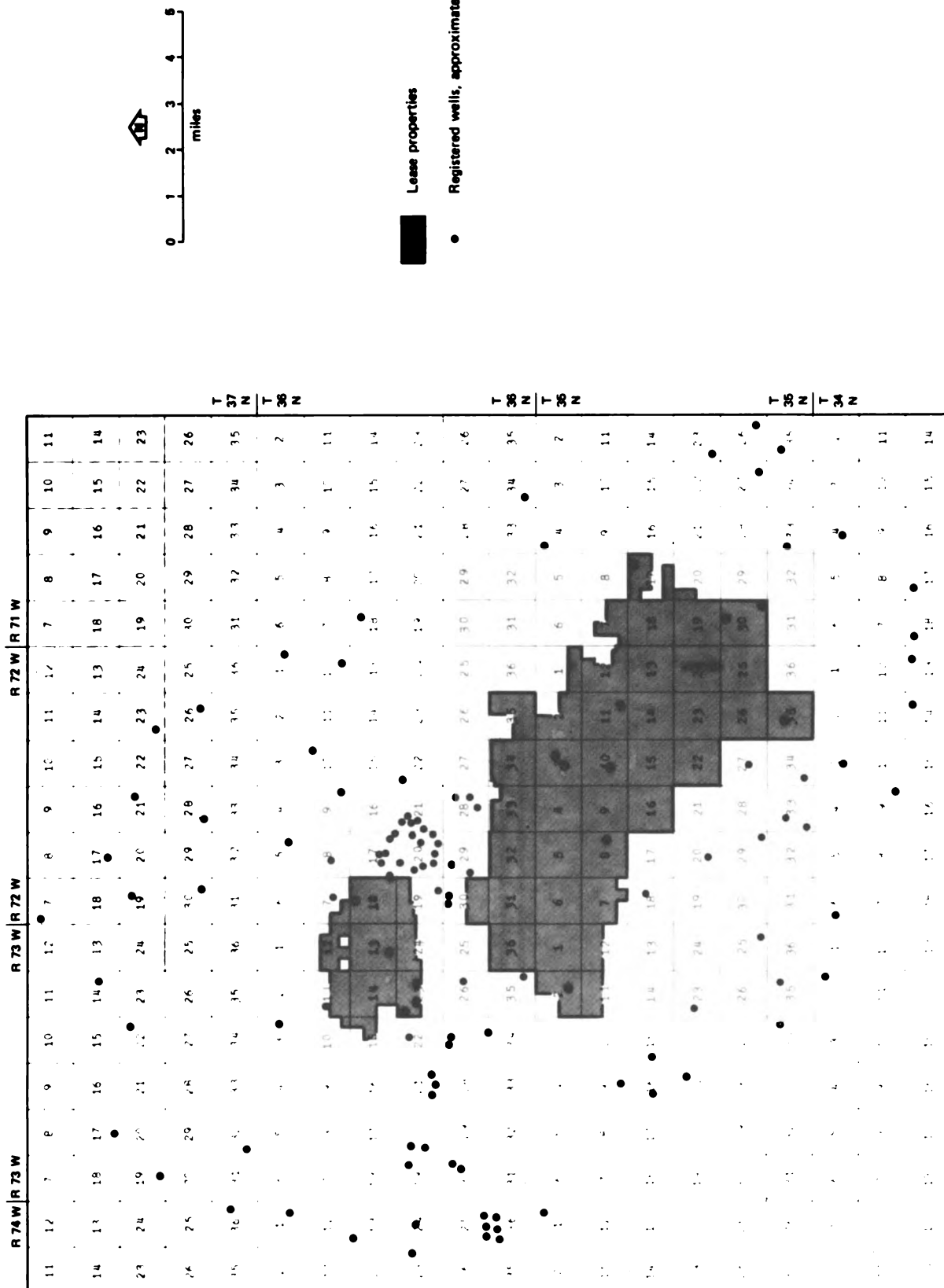
SUMMARY OF SAMPLING AND FIELD ANALYSES OF SURFACE WATER, MORTON RANCH PROPERTY

Location	Sample Number	Date	Source	Field Analyses				Labo- ratory Analyses Performed ^a
				Temp. (°C)	pH	HCO ₃ ⁻ (ppm)	Specific Conductance (umhos/cm)	Alkalinity Chloride (as CaCO ₃)
Proposed Underground Mining Site	TVA-1	10/74 ^b	Stagnant spring in creek bottom	9	7.5	146	890	--
	TVA-2	10/74	Plays, stagnant	13	9.7	25 CO ₃ ²⁻	205	--
	TVA-3	10/74	Stagnant impoundment	20	9.3	25 HCO ₃ ⁻	150	--
Proposed Open Pit Mining Sites	TVA-4	10/74	Slightly flowing spring in Box Creek bottom	10	7.5	138	925	--
	TVA-5	10/74		20	7.8	130	2200	--
	TVA-6	10/74		19	7.6	276	3000	--
	TVA-7	10/74		12	8.0	130	1800	--
	TVA-8	10/74	Slightly flowing spring in south fork of Box Creek	11	7.9	158	2200	--
	TVA-10	10/74		9	7.8	138	620	--
	TVA-12	10/74		11	7.5	102	405	--
	TVA-13	10/74		7	7.0	244	640	--
	TVA-18	10/74		13	7.7	57	360	--
	TVA-19	10/74		14	7.2	105	520	--
Proposed Open Pit Mining Sites	TVA-1A	12/74 ^d	Flowing spring near TVA-4	2.5	8.5 ^c	--	775	342
	TVA-2A	12/74	Flowing spring; same as TVA-5	2.5	7.7 ^c	--	1500	410

^a Legend: R=radioactive; U=uranium; SS=spark source; AA=atomic absorption, selected trace elements.^b October sampling was done October 18-20, 1974.^c Analyzed in laboratory.^d December sampling was done December 18-21, 1974.



3.4-1 SUBWATERSHEDS ON THE MORTON RANCH PROPERTY AND HYDROGRAPH LOCATIONS



3.4-2 WATER WELLS IN THE VICINITY OF THE MORTON RANCH PROPERTY

TH-SMX6402

TH 5

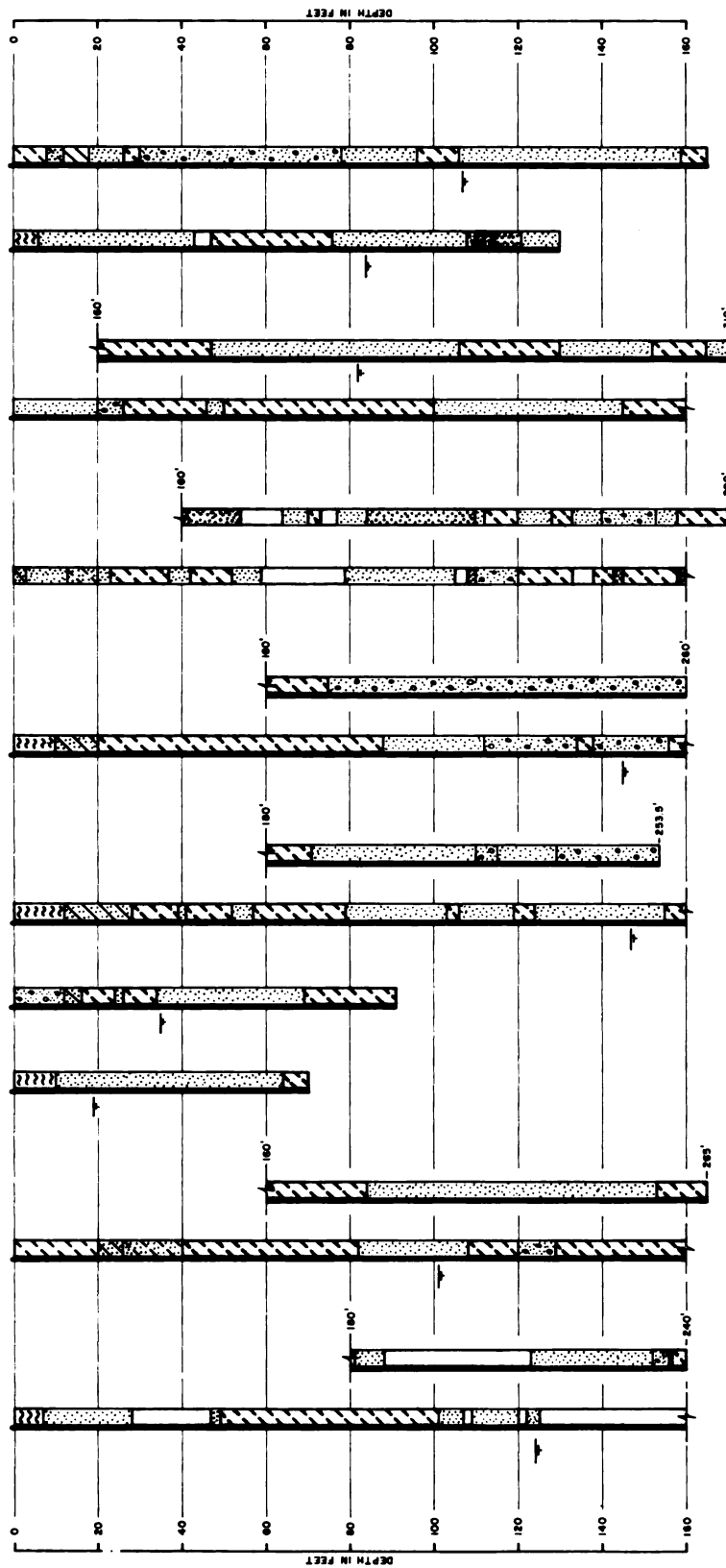
TH-SMX6400 TH-3 TH-SMX6401

TH 2

TH-SMX5913

TH 1

TH-SMX6403 TH 4



LEGEND

SOIL ZONE, LOOSE, SILTY, SANDY, LIGHT TO MEDIUM BROWN.

CLAY, MEDIUM STIFF, SILTY, BROWN.

SAND, MEDIUM DENSE TO DENSE, VERY FINE TO VERY COARSE GRAINED, LOCALLY INTERBEDDED WITH THIN CLAYSTONES, SILTSTONES, SANDSTONES, AND CARBONACEOUS SEAMS, DRY TO WET, GRAY TO DARK BROWN TO REDDISH BROWN.

SAND, LOOSE TO MEDIUM DENSE, CLAYEY, VERY FINE TO MEDIUM GRAINED, DRY TO MOIST, GRAY TO BROWN.

SILT, FIRM, CLAYEY, DRY, GRAY.

SAND, LOOSE TO MEDIUM DENSE, SILTY, FINE TO VERY COARSE GRAINED, DRY, TAN TO BROWN.

SAND, MEDIUM DENSE TO VERY DENSE, GRAVELLY, FINE TO VERY COARSE GRAINED, LOCALLY INTERBEDDED WITH THIN CLAYSTONES AND SILTSTONES, LOCALLY THINLY CEMENTED WITH CALCIUM CARBONATE, DRY TO WET, GRAY TO REDDISH BROWN.

CLAYSTONE MODERATELY HARD TO HARD, LOCALLY SILTY, SANDY, GRAVELLY, LOCALLY INTERBEDDED WITH THIN SANDS, AND COAL SEAMS, DRY TO MOIST, LIGHT GRAY TO BROWN TO BLACK.

SANDSTONE, MODERATELY HARD TO HARD, FINE TO VERY COARSE GRAINED, LOCALLY INTERBEDDED WITH THIN CLAYSTONES, SILTSTONES, AND CARBONACEOUS SEAMS, DRY TO WET, GRAY TO BROWN TO GREEN.

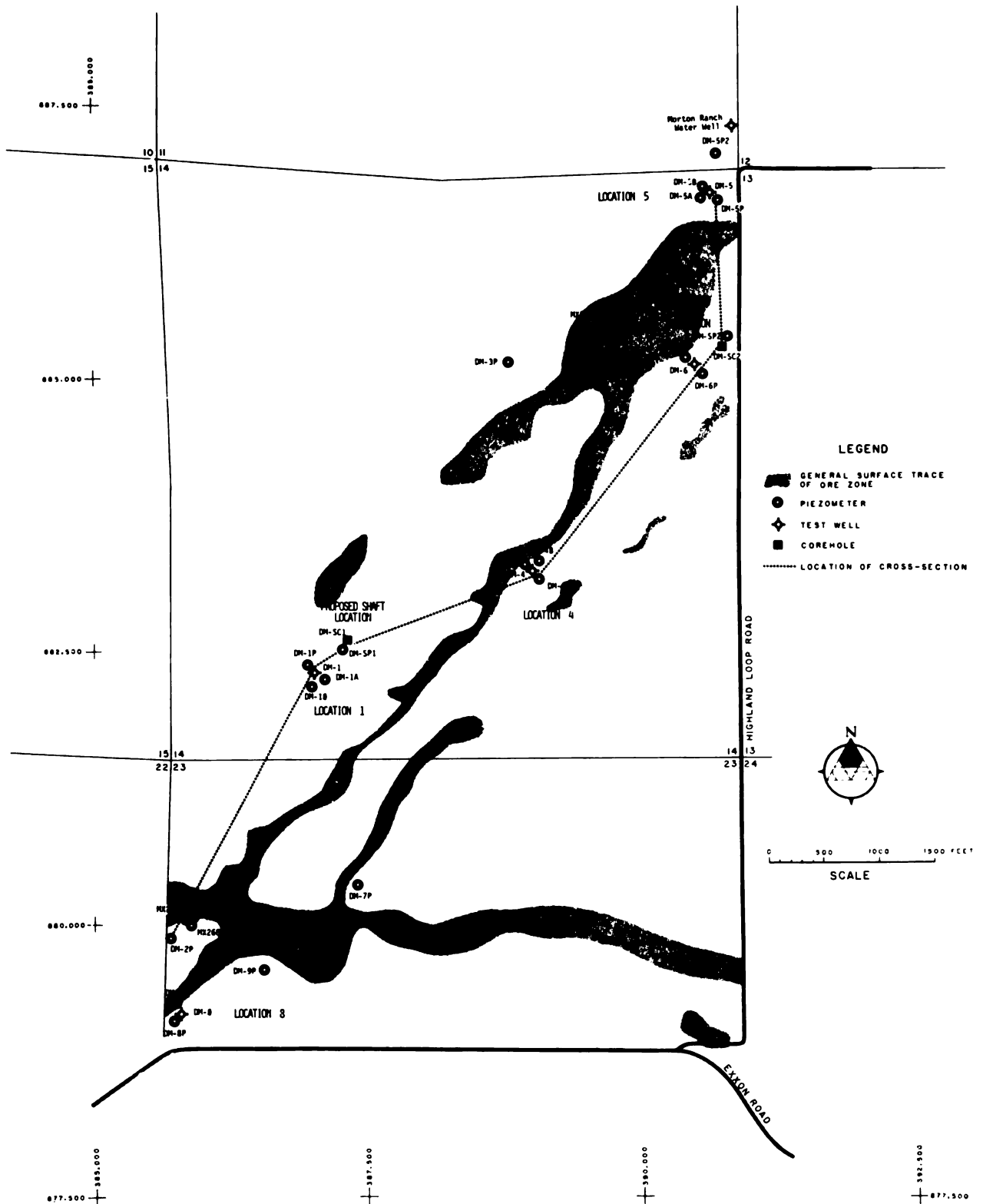
SILTSTONE, MODERATELY HARD, LOCALLY INTERBEDDED WITH THIN CLAYSTONES, SANDSTONES AND CARBONACEOUS SEAMS, DRY TO MOIST, GRAY TO BROWN TO BLACK.

INDICATES FREE WATER LEVEL TAKEN ON DECEMBER 20, 1974.

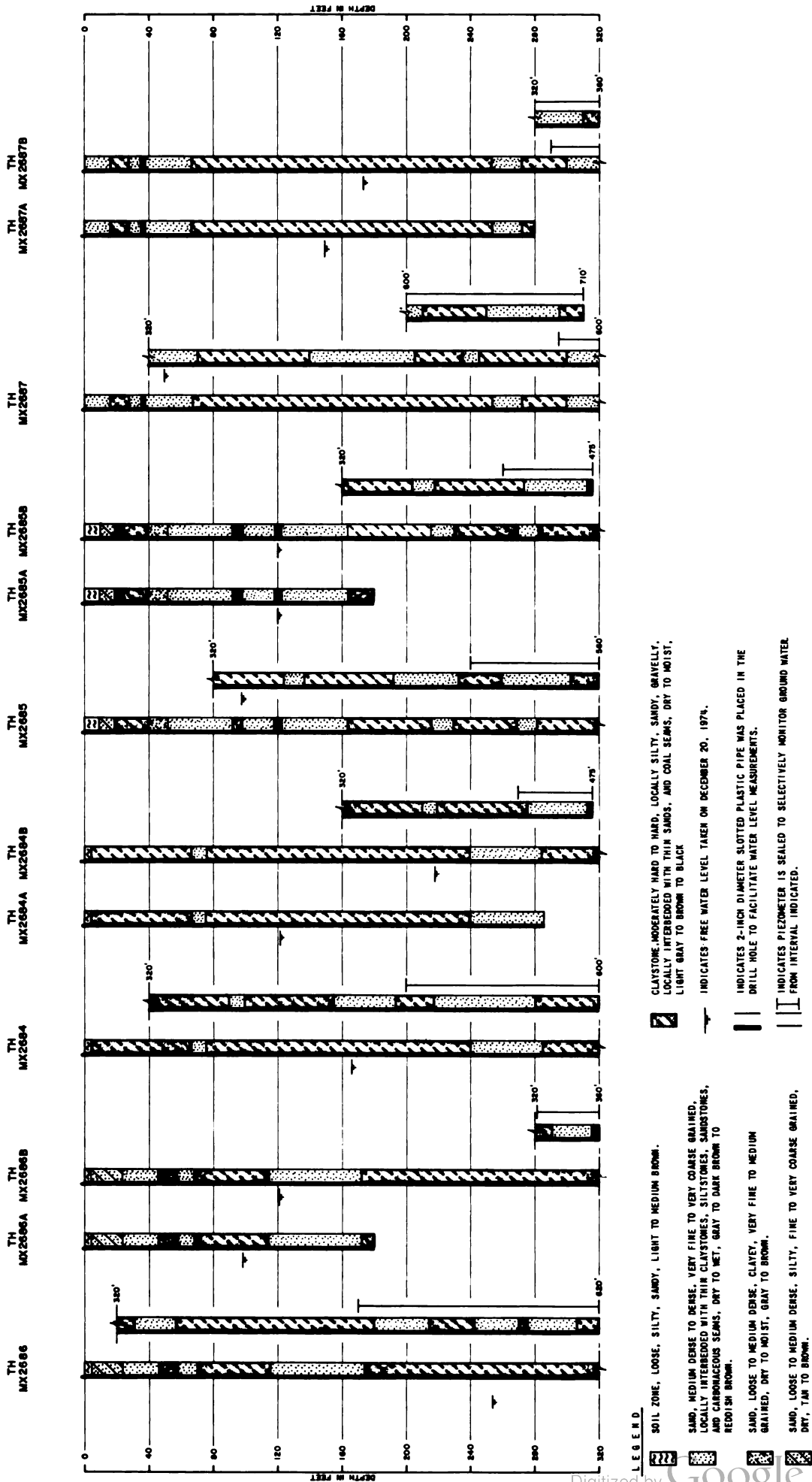
INDICATES 2-INCH DIAMETER SLOTTED PLASTIC PIPE WAS PLACED IN THE DRILL HOLE TO FACILITATE WATER LEVEL MEASUREMENTS.

NOTES:

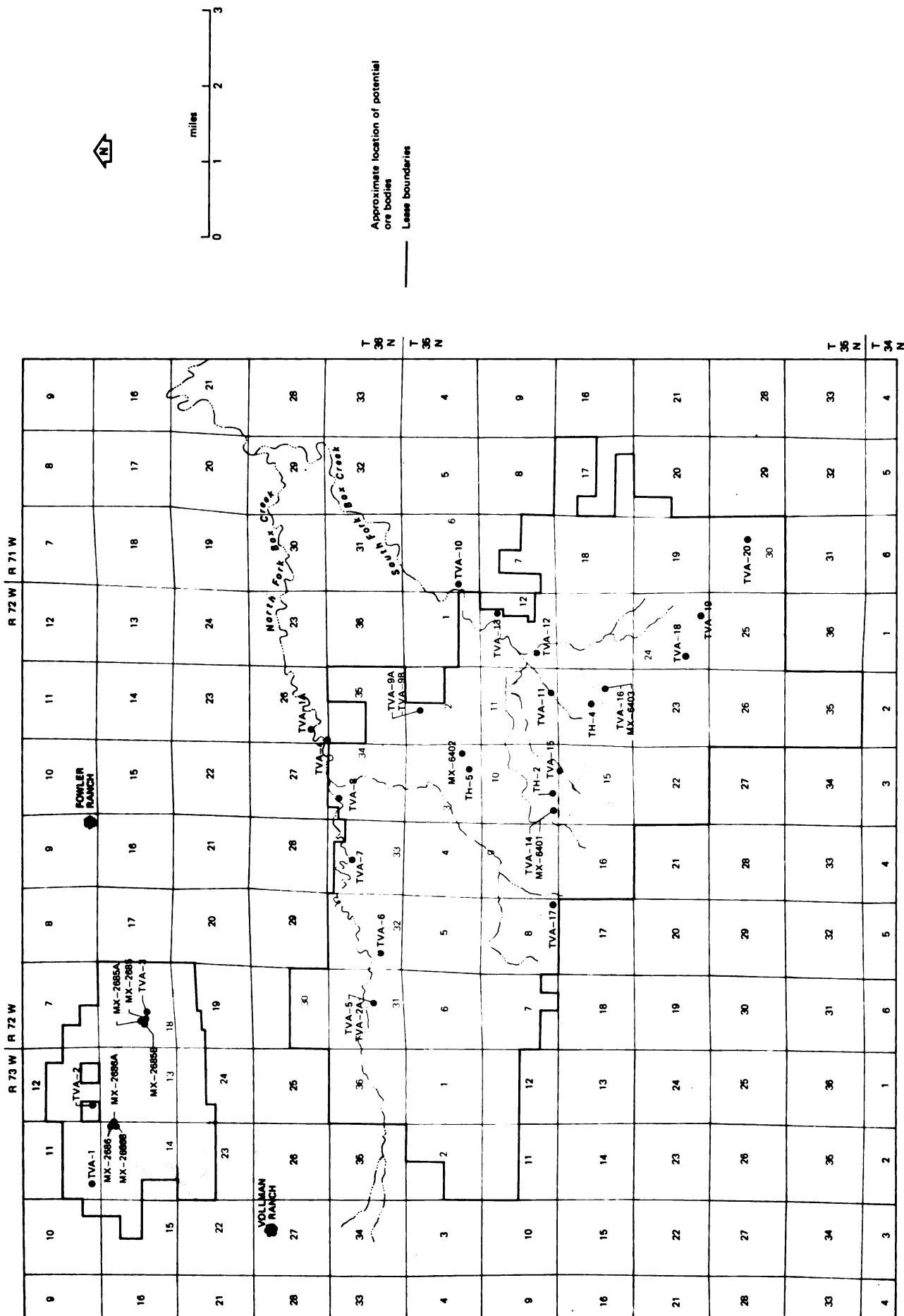
1. TEST HOLES WERE DRILLED OR CORED BETWEEN SEPTEMBER 23, 1974 AND DECEMBER 20, 1974 WITH A 4 1/2 INCH DIAMETER KENCLAW BIT OR AN MC CORE BARREL, POWERED BY A GARDNER-DENVER 1000 DRILLING RIG, USING AIR AND WATER AS DRILLING MEDIUM.
2. DRILL LOGS IN THIS REPORT ARE SUBJECT TO LIMITATIONS, EXPLANATIONS, AND CONCLUSIONS OF THIS REPORT.
3. THESE DRILL LOGS SUMMARIZE FINDINGS RELIED ON IN FORMULATING THE DESIGN CRITERIA PRESENTED IN THIS REPORT. THE EXPLORATIONS WERE NOT MADE TO DEFINE CONDITIONS FOR CONSTRUCTION NOR IS THE INFORMATION PRESENTED HEREIN FOR THAT PURPOSE.



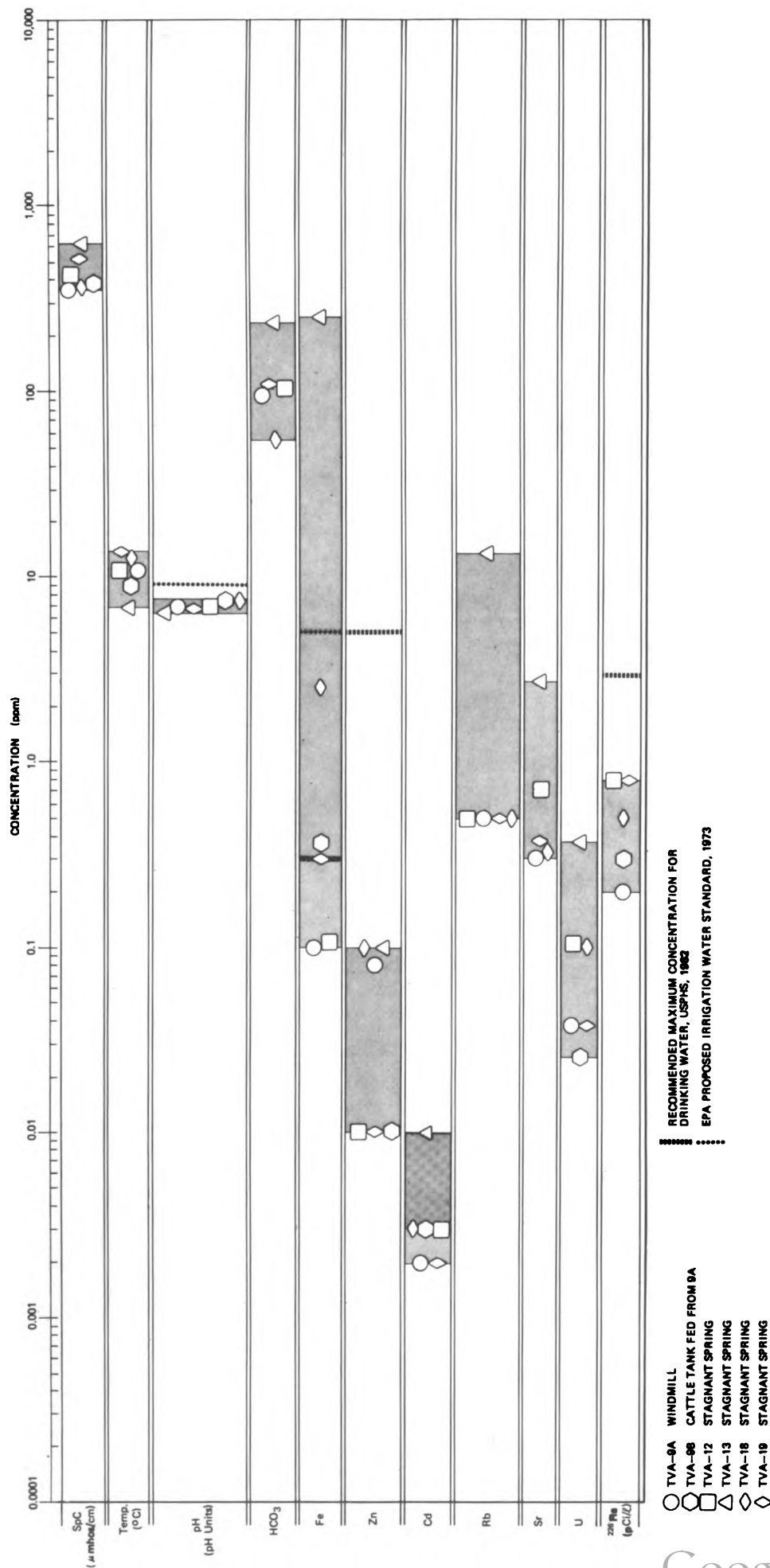
3.4-4 LOCATIONS OF TEST HOLES AND WELLS ON THE NORTHERN PORTION OF THE MORTON RANCH PROPERTY USED FOR THE DAMES AND MOORE STUDY



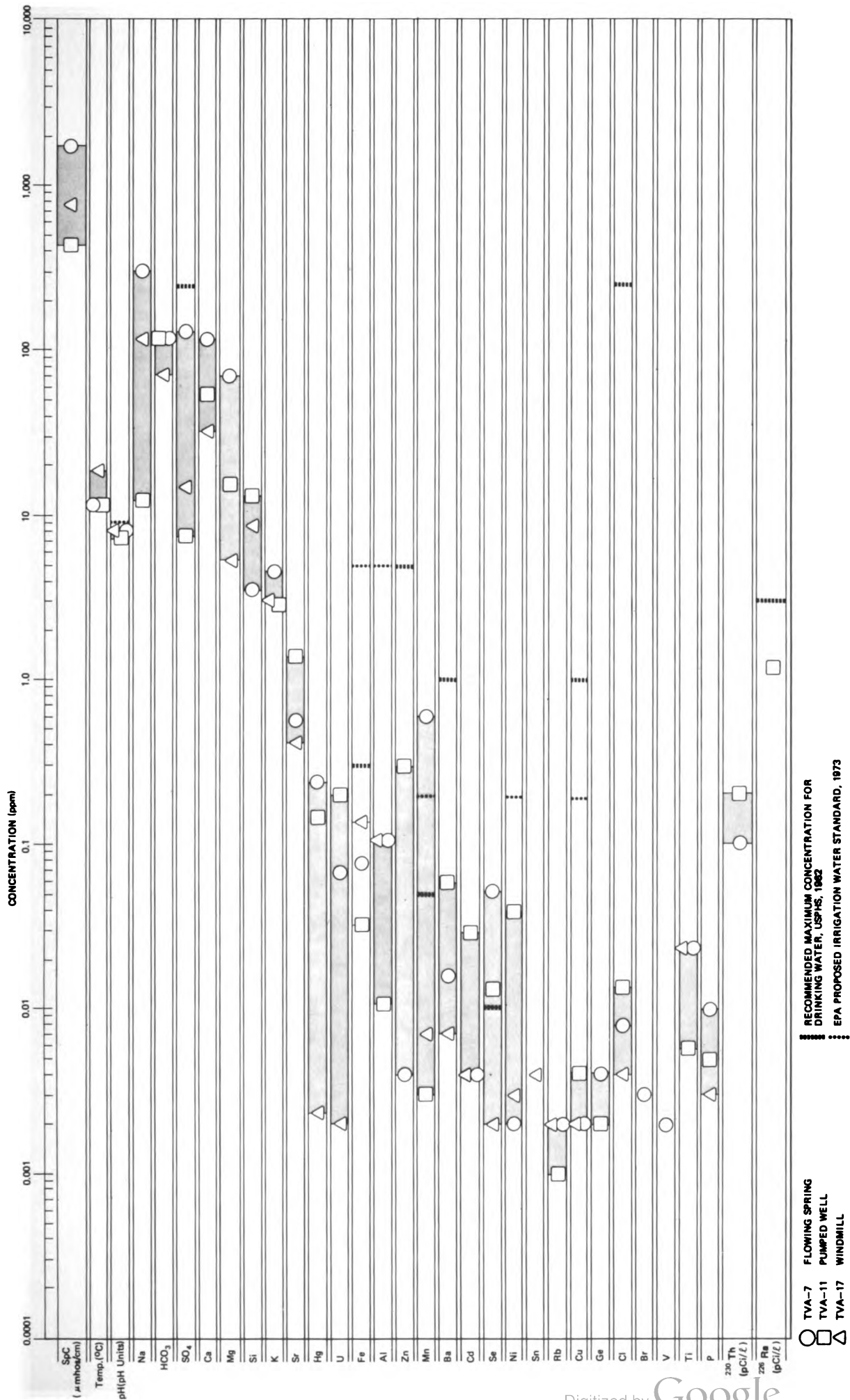
3.4-5 SUMMARY LOGS OF TEST HOLES DRILLED IN THE NORTHERN PORTION OF THE MORTON RANCH PROPERTY



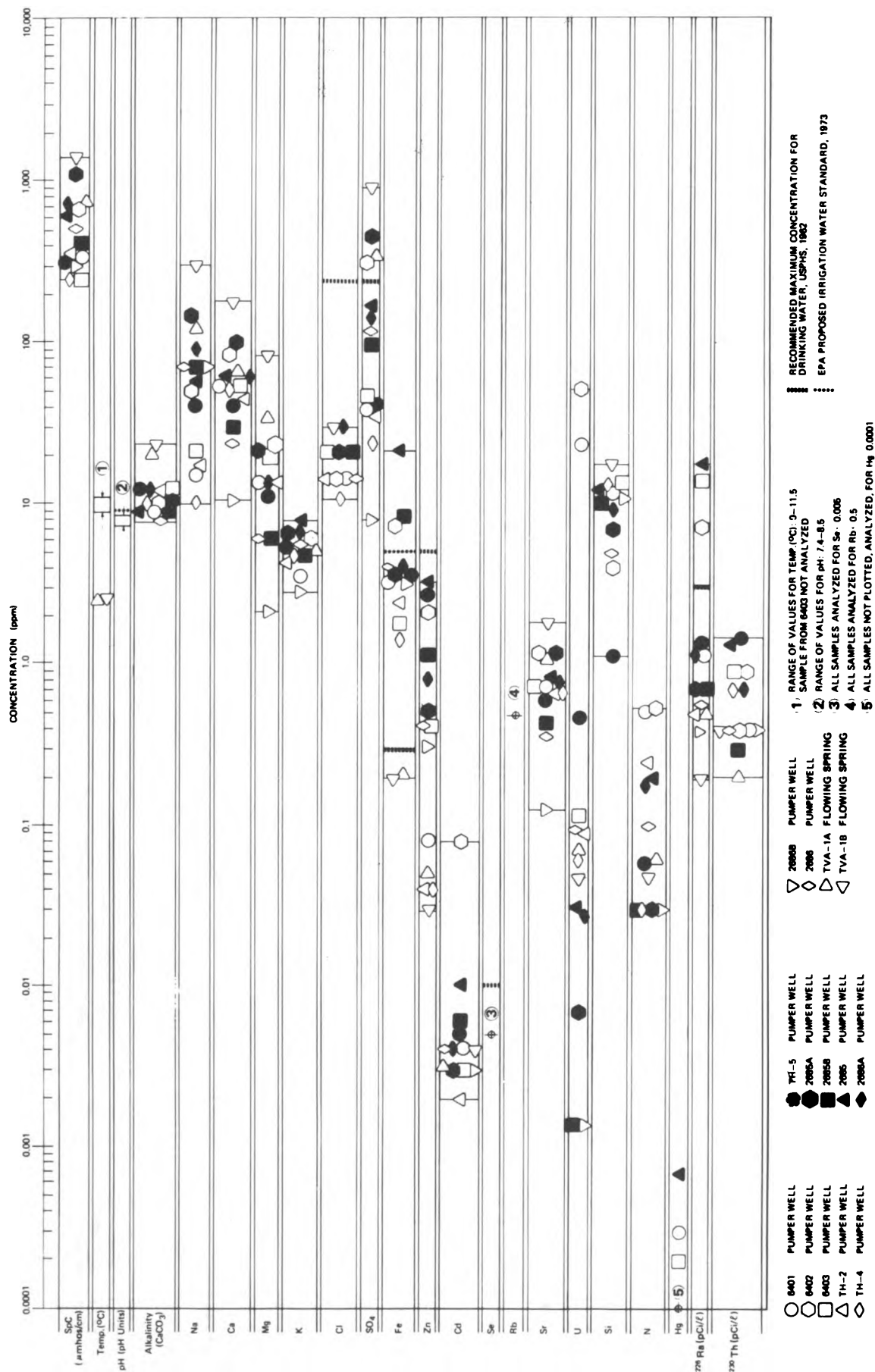
3.4-7 WATER QUALITY SAMPLING SITES



3.4-8 WATER QUALITY ANALYSES FOR SAMPLES COLLECTED AT SIX SITES DURING OCTOBER FIELD PROGRAM



3.4-9 CONCENTRATIONS OF ELEMENTS IN WATER SAMPLES REPRESENTATIVE OF THOSE COLLECTED DURING OCTOBER FIELD PROGRAM



3.4-10 WATER QUALITY ANALYSIS FOR SAMPLES COLLECTED DURING DECEMBER FIELD PROGRAM

3.4 REFERENCES

1. Whitcomb, H. A., et al. 1958. Occurrence of groundwater in the eastern Powder River Basin and western Black Hills, northeastern Wyoming. Wyoming Geological Association Guidebook, 13th Annual Field Conference.
2. Hodson, W. G., et al. 1973. Water resources of the Powder River Basin and adjacent areas, northeastern Wyoming. Hydrologic Investigation Atlas HA-465. Washington, D.C.: U. S. Geological Survey.
3. Dames and Moore. 1975. Dewatering and geotechnical investigation, proposed north Morton Ranch underground uranium mine, Highland Flats, near Douglas, Wyoming. Denver: Dames and Moore.
4. Exxon Company, U.S.A. 1973. Environmental statement: the Highland uranium mill. Docket No. 40-8102. U. S. Atomic Energy Commission.
5. Exxon Company, U.S.A. 1974. Highland uranium operations: water analysis records, 1969-1974.

3.5 CLIMATOLOGY, METEOROLOGY AND AIR QUALITY

1. Significant Weather Factors - The Morton Ranch property is located approximately 200 miles east of the continental divide. Mountain peaks in the west-central portion of the state exceed 13,000 feet, are generally oriented in a north-south direction, and are perpendicular to the prevailing winds. Therefore, the mountain ranges provide effective barriers to the passage of storms and thus to the occurrence of precipitation in the eastern portion of the state.

There are no significant mountain ranges to the east and north of the Morton Ranch property. This allows arctic air masses to move over the area, particularly in winter. Such outbreaks can occur several times a month during the winter, and may be accompanied by blizzard conditions, strong northerly winds, and abrupt temperature changes. As a general rule, the cold arctic air masses modify rapidly after they reach Wyoming.¹ The volumetric water content of winter snow is low because of the cold temperatures at which it usually occurs. The dry, strong west and southwest winds that follow winter storms tend to clear the snow from the ground within several days.

The proposed site lies in an area where the mean annual frequency of tornadoes, during the time period 1953 through 1962, was 0.4 in the one-degree square of latitude and longitude. The probability² of a tornado's striking a point in any year within this one-degree square is calculated at 0.00032. The recurrence interval for a tornado's striking a point within this square is about 3100 years. While tornadoes do occur over Wyoming, they are somewhat smaller and less frequent than the ones that occur to the east.

During the spring and summer, thunderstorms are frequent in Wyoming. As a rule, related precipitation is light, only a few hundredths of an inch. However, several locally heavy storms occur each year which can be expected to produce 1 to 2 inches of rain in a single day. On some occasions from 3 to 5 inches of rain have fallen in 24 hours.¹ The maximum precipitation reported to have fallen within 24 hours at Casper was 3.09 inches in April 1941. The principal damage associated with thunderstorms in the state results from hail; however, hail damage is generally minimal.

Winds of 50 mph or greater have been reported at Casper in every month of the year except November. The strongest wind reported there was 81 mph in March 1956. The mean recurrence interval for wind speeds 30 feet above the ground is estimated for the site area as follows:³

Maximum Speed (mph)	65	70	85	90	100
Recurrence Interval (years)	2	10	25	50	100

Temperature, Precipitation, and Humidity - The climate of the Morton Ranch property can be generally classified as semiarid and cool. Seasonal variations, however, are considerable. The mean monthly temperature for Casper in January, the coldest month, is 23.2° F; the mean monthly temperature for July, the warmest month, is 71.0° F. The highest temperature reported at Casper was 104° F in July 1954. The extreme low was -40° F in January 1970 and 1972.

A 24-hour daily record of temperature data for the Morton Ranch property was examined for the period from August 24 through

November 4, 1974 and was compared with concurrent data obtained at the Natrona County International Airport. In general, the average daily minimum temperatures were several degrees lower at Casper than at the proposed site, and the average daily maximum temperatures were several degrees higher at Casper than at the Morton Ranch site. The mean temperatures for both months showed less than 1° F difference between the two locations.

For the period 1941 through 1970 the total annual precipitation in the Casper area has averaged 11.22 inches. The wettest month is May (mean precipitation, 1.94 inches), and the driest month is December (mean precipitation, 0.49 inches). A minimum annual precipitation of 7.34 inches was reported in 1960, while a maximum of 16.24 inches was reported in 1941. On a monthly basis, a maximum value for the 34-year period was 5.75 inches of precipitation, reported in April 1941. Wide seasonal and annual variations in amounts of precipitation are the result of variations in spring and summer thunderstorm activity. Several heavy thunderstorms in a year can produce 25 percent to 50 percent of the annual precipitation. Precipitation records provided by the Wyoming state climatologist¹ for 1935 to 1955 indicate that Casper data are representative of the long-term pattern over the east-central part of the state.

Table 3.5-1 presents the estimated maximum precipitation at any location on the property (point precipitation) for specific durations and recurrence intervals.^{4,5}

Snowfall averages about 72 inches in the Casper area annually. A maximum of 116.8 inches was reported at Casper during the 1972/1973 season; and a minimum of 33.6 inches was reported during the 1941/1942 season. A maximum of 56.3 inches for an individual month was reported in April 1973.⁶

The absolute moisture content of the air at the site is normally quite low. Cool temperatures, however, keep the relative humidity at moderate levels, particularly during the winter.

Wind Speed and Direction - Long term Casper wind data indicate that winds in the site area prevail from the southwest. The mean wind speed is 13.1 mph, with winds during December and January averaging more than 16 mph.⁶

Wind roses for the Morton Ranch and Casper areas for the concurrent observation period of September through October 1974 are shown in Figures 3.5-1 and 3.5-2, respectively. Both wind roses show prevailing winds from the southwest with a secondary maximum of wind direction frequencies in the northern sectors during this period. The Morton Ranch data show greater wind frequencies from the west than at Casper, while Casper data show greater wind frequencies from the southwest than at Morton Ranch. Wind speeds at the proposed site appear to be, on the average, two mph stronger than those at Casper. Figure 3.5-3 presents a wind rose for Casper for September through October over the five-year period, 1967 through 1971. The 1974 Casper and Morton Ranch data are generally in good

agreement with these longer term data. Thus, the Casper data appear to be adequate for use in atmospheric dispersion calculations for the site.

Figure 3.5-4 presents the annual wind rose for the same five-year period used to derive the two-month wind rose (Figure 3.5-3). This annual wind rose shows good agreement with the three two-month wind roses (Figures 3.5-1 through 3.5-3), including the prevailing southwest wind direction.

2. On-Site Meteorological Program - An onsite meteorological program was initiated August 22, 1974 in order to provide a sufficient meteorological base, should a uranium mill be added at the site in the future. Meteorological equipment erected and installed at the site consists of a mechanical weather station mounted on a 10-meter "fold-over" tower. Meteorological parameters measured are wind speed, wind direction, and temperature.

The base of the meteorological tower is at an elevation of 5320 feet, placing the measuring equipment at an elevation of approximately 5353 feet mean sea level (MSL). This compares favorably with data collected from the Natrona County International Airport which is at an elevation of 5338 feet MSL. Comparisons were made between on-site data and National Weather Service (NWS) Casper data obtained at the Natrona County International Airport. Comparisons were also made between onsite data and long-term local and regional climatological data, using Wyoming climatological records, the Local Climatological Data (LCD) for Casper, and the National Climatic Center Star Program for Casper.

3. Air Quality - Both nonradiological and radiological air quality are discussed below.

Nonradiological - The proposed project site is in the Casper Intrastate Air Quality Control Region. The region has been classified by the U.S. Environmental Protection Agency as Priority III for sulfur dioxide, nitrogen dioxide, carbon monoxide, and oxidants; therefore, for those emissions, no limitations on equipment are required to meet ambient standards. For particulates, the region has been classified as Priority II, which means some particulate emission limitations on equipment may be needed to achieve ambient standards. The State of Wyoming's ambient air quality standards for those emissions are presented in Table 3.5-2. These standards meet or exceed existing Federal Ambient Air Quality Standards.

An onsite preoperational air sampling effort was performed using the high-volume method. The sample locations are shown in Figure 3.5-5. Particulate sample analyses are presented in Table 3.5-3. The measured particulate concentrations are less than state and Federal 24-hour-average standards. Results of this preoperational survey are consistent with concentrations measured at other times of the year by a neighboring mining operation.* Figures 3.5-6 and 3.5-7 present the annual geometric mean trends for particulates and arithmetic mean trends for SO_2 , respectively, for the Casper area, which is considered to be conservatively representative of the proposed site.

* Particulate concentrations were measured at four locations around the perimeter of the Highland uranium mine and mill operation three times during 1974. Reported concentrations averaged $33 \mu\text{g}/\text{m}^3$ and ranged between 8 and $123 \mu\text{g}/\text{m}^3$ for 24-hour averages.

Radiological - Surface soils and rocks of the Morton Ranch property, and nearby mining, milling, and exploratory operations serve as sources of natural particulate and gaseous radioactive materials. Gaseous radon-222 present in the air is a decay product of radium in the native soil and rock. Radon decay results in the formation of radioactive daughter products which deposit on existing particulates. The sizes of airborne particles range from sand and silt sizes down to near-molecular sizes.

Background concentrations of airborne radioactive materials were measured onsite. The samples were chemically analyzed for natural uranium, thorium-230, and radium-226. Concentrations and activities of these materials are reported in Table 3.5-3.

Six particulate samples were collected at four locations on October 14, 1974, to estimate background radon-222 concentrations. Each sample was analyzed for radon-222 daughters immediately after collection, using an alpha-particle detector and counting system. The sample locations, RN1 through RN6, are indicated in Figure 3.5-5, and the alpha analysis results are presented in Table 3.5-4.

The reported polonium-218 concentrations indicate the concentrations of radon-222 required to support this daughter. Analysis results indicated the radionuclides were close to being in equilibrium conditions.

The reduction in concentrations from early-morning sampling to late-afternoon sampling can be attributed to an increase in atmospheric

mixing, as solar heating and wind speeds increased during the day. Sample location appears not to have influenced observed concentrations significantly. The indicated radon concentrations agree with other concentrations reported for surface air over land. Average concentrations of 1×10^{-10} and 2×10^{-10} $\mu\text{Ci}/\text{ml}$ have been reported.^{7,8}

4. Diffusion Climatology - Based on the input parameters of solar altitude, cloud cover, ceiling height, and wind speed, atmospheric stability is classified as follows:

<u>Pasquill Stability Classification</u>	<u>Degree of Atmospheric Stability</u>
A	Extremely unstable
B	Unstable
C	Slightly unstable
D	Neutral
E	Slightly stable
F	Stable
G	Extremely stable

Table 3.5-5 presents a summary of monthly and annual occurrences of Pasquill stability classes for Casper, Wyoming, based on the National Climatic Center Star Program for July 1967 through December 1971. The joint-frequency distribution of wind direction and speed by Pasquill stability class as calculated from the "star" program for Casper data are given in Tables 3.5-6 through 3.5-11. Good diffusion conditions (Pasquill stability classes A through D) occur 75.7 percent of the time and are primarily the result of moderate to strong winds, which occur over the rolling hills through most of the year.

Since initial investigations indicate wind speeds to be somewhat stronger at the proposed Morton Ranch site than at Casper, the calculations made to support a prediction of favorable diffusion characteristics at Casper are considered to be conservative with respect to the project site.

TABLE 3.5-1

**ESTIMATED MAXIMUM POINT PRECIPITATION (inches) FOR SELECTED
DURATIONS AND RECURRENCE INTERVALS FOR THE MORTON RANCH SITE**

<u>Duration</u>	<u>Recurrence Interval</u>				
	<u>2 years</u>	<u>10 years</u>	<u>25 years</u>	<u>50 years</u>	<u>100 years</u>
1 hour	0.9	1.4	1.8	2.0	2.3
12 hours	1.5	2.4	2.8	3.2	3.6
24 hours	1.7	2.8	3.2	3.6	4.0
2 days	1.8	3.0	3.6	4.0	4.5
7 days	2.5	3.9	4.5	5.4	5.8
10 days	2.8	4.1	5.0	5.6	6.4

TABLE 3.5-2

WYOMING AMBIENT AIR QUALITY STANDARDS

Standard	Carbon Monoxide (ppm)	Oxidants (ppm)	Nitrogen Dioxide (ppm)	Suspended Particulates ($\mu\text{g}/\text{m}^3$)	Sulfur Dioxide (ppm)
1-hour	35	0.08	---	---	---
3-hour	---	---	---	---	0.50
8-hour	9	---	---	---	---
24-hour	---	---	---	150	0.10
Annual	---	---	0.05	60	0.02

Source: The Bureau of National Affairs, Incorporated, Environment Reporter.

Note: The Wyoming Ambient Air Quality Standards meet or exceed the Federal Standards.

Table 3.5-3
BACKGROUND AIRBORNE PARTICULATE SAMPLE ANALYSIS RESULTS

Parameter	Concentration	Particulate Activities*
Date: October 12, 1974		
Sample: HV1		
Volume: 33,000 scf		
Mean Wind Direction: SSW**		
Wind Direction Range: SSE-W		
Mean Wind Speed: 11.2 mph		
Sky: Mostly Scattered		
Particulates	14 μ g/m ³ $\pm$ 11%	_____
Natural Uranium	4.3 x 10 ⁻¹⁶ μ Ci/mL $\pm$ 19%	3.1 x 10 ⁻⁸ μ Ci/mg $\pm$ 26%
Thorium-230	1.4 x 10 ⁻¹⁵ μ Ci/mL $\pm$ 34%	1.0 x 10 ⁻⁷ μ Ci/mg $\pm$ 41%
Radium-226	1.5 x 10 ⁻¹⁵ μ Ci/mL $\pm$ 21%	1.1 x 10 ⁻⁷ μ Ci/mg $\pm$ 27%
Date: October 13, 1974		
Sample: HV2		
Volume: 35,500 scf		
Mean Wind Direction: N		
Wind Direction Range: WNW-NNE		
Mean Wind Speed: 23.2 mph		
Sky: Broken Overcast		
Particulates	41 μ g/m ³ $\pm$ 15%	_____
Natural Uranium	6.8 x 10 ⁻¹⁶ μ Ci/mL $\pm$ 25%	1.6 x 10 ⁻⁸ μ Ci/mg $\pm$ 21%
Thorium-230	2.2 x 10 ⁻¹⁵ μ Ci/mL $\pm$ 41%	5.2 x 10 ⁻⁸ μ Ci/mg $\pm$ 33%
Radium-226	1.6 x 10 ⁻¹⁵ μ Ci/mL $\pm$ 25%	4.0 x 10 ⁻⁸ μ Ci/mg $\pm$ 19%

*Particulate activities are in units of microcuries of radionuclide per milligram of particulates.

**Wind direction and speed data obtained from onsite mechanical weather station records.

Table 3.5-4

BACKGROUND AIRBORNE RADON DAUGHTER CONCENTRATIONS, OCTOBER 14, 1974

	Parameters	Concentration ($\mu\text{Ci}/\text{mL}$)
Sample: RN1	^{218}Po	$0.98 \times 10^{-9} \pm 9.3\%$
Time: 0730 MDT*	^{214}Pb	$0.82 \times 10^{-9} \pm 3.5\%$
Wind Direction: E**	^{214}Bi	$0.57 \times 10^{-9} \pm 5.3\%$
Wind Speed: 1 mph		
Sky: Clear		
Sample: RN2	^{218}Po	$1.03 \times 10^{-9} \pm 7.4\%$
Time: 0934 MDT	^{214}Pb	$0.80 \times 10^{-9} \pm 3.1\%$
Wind Direction: ENE	^{214}Bi	$0.22 \times 10^{-9} \pm 11.9\%$
Wind Speed: 2 mph		
Sky: Clear		
Sample: RN3	^{218}Po	$0.62 \times 10^{-10} \pm 58.6\%$
Time: 1142 MDT	^{214}Pb	$1.15 \times 10^{-10} \pm 9.9\%$
Wind Direction: W	^{214}Bi	$1.27 \times 10^{-10} \pm 9.7\%$
Wind Speed: 8 mph		
Sky: Clear		
Sample: RN4	^{218}Po	$1.52 \times 10^{-10} \pm 20.7\%$
Time: 1330 MDT	^{214}Pb	$1.14 \times 10^{-10} \pm 8.7\%$
Wind Direction: WNW	^{214}Bi	$0.50 \times 10^{-10} \pm 21.7\%$
Wind Speed: 12 mph		
Sky: Clear		
Sample: RN5	^{218}Po	$1.40 \times 10^{-10} \pm 22.0\%$
Time: 1450 MDT	^{214}Pb	$0.89 \times 10^{-10} \pm 10.7\%$
Wind Direction: NW	^{214}Bi	$0.59 \times 10^{-10} \pm 17.3\%$
Wind Speed: 12 mph		
Sky: Clear		
Sample: RN6	^{218}Po	$0.33 \times 10^{-10} \pm 73.9\%$
Time: 1545 MDT	^{214}Pb	$0.57 \times 10^{-10} \pm 13.6\%$
Wind Direction: NW	^{214}Bi	$0.46 \times 10^{-10} \pm 17.8\%$
Wind Speed: 12 mph		
Sky: Clear		

*MDT = Mountain Daylight Time.

**Reported wind direction and speed data were obtained from onsite mechanical weather station records.

TABLE 3.5-5

**PERCENT FREQUENCY OF PASQUILL STABILITY CLASSES BY MONTH
FOR CASPER, WYOMING, 1967 - 1971**

<u>Month</u>	<u>Class</u>					
	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>	<u>F</u>
January	0.0	0.1	1.4	84.6	9.8	4.2
February	0.0	0.4	2.9	78.3	12.7	5.6
March	0.0	1.7	2.7	80.7	10.2	4.6
April	0.0	2.4	6.3	70.3	13.3	7.8
May	1.1	4.8	11.0	59.6	12.3	11.2
June	1.8	9.0	12.0	47.8	15.2	14.2
July	3.5	10.8	14.9	34.4	16.9	19.5
August	1.1	11.4	16.5	33.6	17.3	20.2
September	0.2	4.6	8.7	52.0	18.9	15.5
October	0.0	0.1	4.5	66.9	16.3	11.3
November	0.0	0.2	3.0	77.2	12.5	7.2
December	0.0	0.0	1.7	82.1	11.9	4.4
Annual	0.7	3.9	7.2	63.9	13.9	10.5

Source: National Climatic Center Star Program, U.S. Department of Commerce, 1973.

Table 3.5-6

ANNUAL RELATIVE FREQUENCY DISTRIBUTION, CASPER, WYOMING, 1967-1971 (A Stability)

Direction	Wind Speed (knots)						Total
	0 - 3	4 - 6	7 - 10	11-16	17-21	>21	
N	0.000069	0.000137	- - -	- - -	- - -	- - -	0.000206
NNE	0.000240	0.000274	- - -	- - -	- - -	- - -	0.000514
NE	0.000103	0.000206	- - -	- - -	- - -	- - -	0.000308
ENE	0.000240	0.000069	- - -	- - -	- - -	- - -	0.000308
E	0.000171	0.000137	- - -	- - -	- - -	- - -	0.000308
ESE	0.000103	0.000206	- - -	- - -	- - -	- - -	0.000308
SE	0.000069	0.000137	- - -	- - -	- - -	- - -	0.000206
SSE	0.000411	0.000617	- - -	- - -	- - -	- - -	0.001028
S	0.000137	0.000069	- - -	- - -	- - -	- - -	0.000206
SSW	0.000206	0.000206	- - -	- - -	- - -	- - -	0.000411
SW	0.000240	0.000069	- - -	- - -	- - -	- - -	0.000308
WSW	0.000240	0.000274	- - -	- - -	- - -	- - -	0.000514
W	0.000377	0.000548	- - -	- - -	- - -	- - -	0.000925
WNW	0.000171	0.000343	- - -	- - -	- - -	- - -	0.000514
NW	0.000206	0.000000	- - -	- - -	- - -	- - -	0.000206
NNW	0.000103	0.000206	- - -	- - -	- - -	- - -	0.000308
TOTAL	0.003083	0.003494	- - -	- - -	- - -	- - -	

Relative Frequency of Occurrence of A Stability = 0.006576

Relative Frequency of Calms Distributed Above With A Stability = 0.002192

Table 3.5-7

ANNUAL RELATIVE FREQUENCY DISTRIBUTION, CASPER, WYOMING, 1967-1971 (B Stability)

Direction	Wind Speed (knots)						Total
	0 - 3	4 - 6	7 - 10	11-16	17-21	>21	
N	0.000554	0.000959	0.000685	- - -	- - -	- - -	0.002198
NNE	0.000507	0.001233	0.000617	- - -	- - -	- - -	0.002356
NE	0.000374	0.000685	0.000685	- - -	- - -	- - -	0.001744
ENE	0.000421	0.000411	0.000411	- - -	- - -	- - -	0.001243
E	0.000960	0.001233	0.000617	- - -	- - -	- - -	0.002810
ESE	0.000424	0.001165	0.000206	- - -	- - -	- - -	0.001794
SE	0.000665	0.001302	0.000548	- - -	- - -	- - -	0.002515
SSE	0.000651	0.001165	0.000274	- - -	- - -	- - -	0.002089
S	0.000977	0.002124	0.000548	- - -	- - -	- - -	0.003649
SSW	0.000410	0.001028	0.000685	- - -	- - -	- - -	0.002122
SW	0.000618	0.001576	0.000822	- - -	- - -	- - -	0.003015
WSW	0.000445	0.001370	0.001096	- - -	- - -	- - -	0.002911
W	0.001126	0.001370	0.001781	- - -	- - -	- - -	0.004277
WNW	0.000402	0.000959	0.000685	- - -	- - -	- - -	0.002046
NW	0.000208	0.000548	0.000754	- - -	- - -	- - -	0.001510
NNW	0.000644	0.001096	0.000822	- - -	- - -	- - -	0.002562
TOTAL	0.009385	0.018222	0.011234	- - -	- - -	- - -	

Relative Frequency of Occurrence of B Stability = 0.038841

Relative Frequency of Calms Distributed Above With B Stability = 0.002603

Table 3.5-8

ANNUAL RELATIVE FREQUENCY DISTRIBUTION, CASPER, WYOMING, 1967-1971 (C Stability)

Direction	Wind Speed (knots)						Total
	0 - 3	4 - 6	7 - 10	11-16	17-21	>21	
N	0.000186	0.000959	0.002535	0.000274	0.000000	0.000000	0.003954
NNE	0.000133	0.001370	0.001850	0.000137	0.000069	0.000000	0.003558
NE	0.000115	0.000959	0.001576	0.000137	0.000000	0.000000	0.002786
ENE	0.000118	0.001028	0.001713	0.000137	0.000000	0.000000	0.002995
E	0.000366	0.001781	0.002329	0.000343	0.000000	0.000000	0.004819
ESE	0.000186	0.000959	0.001918	0.000343	0.000000	0.000000	0.003406
SE	0.000127	0.001233	0.001233	0.000137	0.000000	0.000000	0.002730
SSE	0.000037	0.000822	0.000822	0.000000	0.000000	0.000000	0.001681
S	0.000282	0.001507	0.001233	0.000343	0.000137	0.000000	0.003502
SSW	0.000186	0.000959	0.001987	0.000959	0.000069	0.000000	0.004159
SW	0.000186	0.000959	0.003699	0.002055	0.000343	0.000069	0.007310
WNW	0.000292	0.001713	0.006439	0.001713	0.000343	0.000137	0.010635
W	0.000179	0.002398	0.004727	0.001918	0.000411	0.000069	0.009701
WNW	0.000273	0.001302	0.002261	0.000343	0.000206	0.000000	0.004383
NW	0.000320	0.000754	0.001644	0.000411	0.000000	0.000000	0.003129
NNW	0.000028	0.000617	0.001576	0.000685	0.000000	0.000000	0.002905
TOTAL	0.003014	0.019318	0.037539	0.009933	0.001576	0.000274	

Relative Frequency of Occurrence of C Stability = 0.071654

Relative Frequency of Calms Distributed Above With C Stability = 0.000959

Table 3.5-9

ANNUAL RELATIVE FREQUENCY DISTRIBUTION, CASPER, WYOMING, 1967-1971 (D Stability)

Direction	Wind Speed (knots)						Total
	0 - 3	4 - 6	7 - 10	11-16	17-21	>21	
N	0.000792	0.005412	0.011440	0.011097	0.002809	0.001028	0.032577
NNE	0.001053	0.005823	0.014249	0.014865	0.003768	0.001028	0.040785
NE	0.000854	0.004453	0.010207	0.010275	0.001713	0.000274	0.027775
ENE	0.000741	0.003220	0.008768	0.006508	0.000617	0.000000	0.019854
E	0.000598	0.004110	0.009248	0.010001	0.002261	0.000137	0.026355
ESE	0.000592	0.003220	0.004932	0.005480	0.000822	0.000069	0.015115
SE	0.000548	0.001918	0.003014	0.001987	0.000411	0.000000	0.007878
SSE	0.000268	0.001302	0.001370	0.000548	0.000137	0.000000	0.003625
S	0.000548	0.001918	0.002124	0.003699	0.001781	0.000411	0.010481
SSW	0.000336	0.001233	0.006302	0.030826	0.026716	0.014797	0.080210
SW	0.000411	0.002055	0.014180	0.065420	0.050075	0.022469	0.154610
WSW	0.000530	0.003357	0.021304	0.051993	0.022126	0.009727	0.109038
W	0.000679	0.003357	0.017468	0.019318	0.009248	0.005206	0.055276
NNW	0.000816	0.002398	0.005412	0.009453	0.004042	0.001165	0.023285
NW	0.000430	0.001439	0.005206	0.005891	0.002398	0.000411	0.015774
NNW	0.001009	0.004521	0.005001	0.004042	0.001028	0.000343	0.015943
TOTAL	0.010207	0.049733	0.140224	0.251404	0.129949	0.057063	

Relative Frequency of Occurrence of D Stability = 0.638581

Relative Frequency of Calms Distributed Above With D Stability = 0.005001

Table 3.5-10

ANNUAL RELATIVE FREQUENCY DISTRIBUTION, CASPER, WYOMING, 1967-1971 (E Stability)

Direction	Wind Speed (knots)						Total
	0 - 3	4 - 6	7 - 10	11-16	17-21	>21	
N	- - -	0.004179	0.003425	- - -	- - -	- - -	0.007604
NNE	- - -	0.003357	0.003014	- - -	- - -	- - -	0.006371
NE	- - -	0.002877	0.002809	- - -	- - -	- - -	0.005686
ENE	- - -	0.001918	0.002877	- - -	- - -	- - -	0.004795
E	- - -	0.002603	0.004042	- - -	- - -	- - -	0.006645
ESE	- - -	0.001576	0.003083	- - -	- - -	- - -	0.004658
SE	- - -	0.001507	0.001165	- - -	- - -	- - -	0.002672
SSE	- - -	0.001028	0.000480	- - -	- - -	- - -	0.001507
S	- - -	0.001370	0.000548	- - -	- - -	- - -	0.001918
SSW	- - -	0.001165	0.004042	- - -	- - -	- - -	0.005206
SW	- - -	0.002466	0.010892	- - -	- - -	- - -	0.013358
WSW	- - -	0.004932	0.028223	- - -	- - -	- - -	0.033155
W	- - -	0.007467	0.019044	- - -	- - -	- - -	0.026510
WNW	- - -	0.003631	0.004042	- - -	- - -	- - -	0.007672
NW	- - -	0.003288	0.002466	- - -	- - -	- - -	0.005754
NNW	- - -	0.003288	0.002603	- - -	- - -	- - -	0.005891
TOTAL	- - -	0.046650	0.092752	- - -	- - -	- - -	

Relative Frequency of Occurrence of E Stability = 0.139403

Relative Frequency of Calms Distributed Above With E Stability = 0.000000

Table 3.5-11

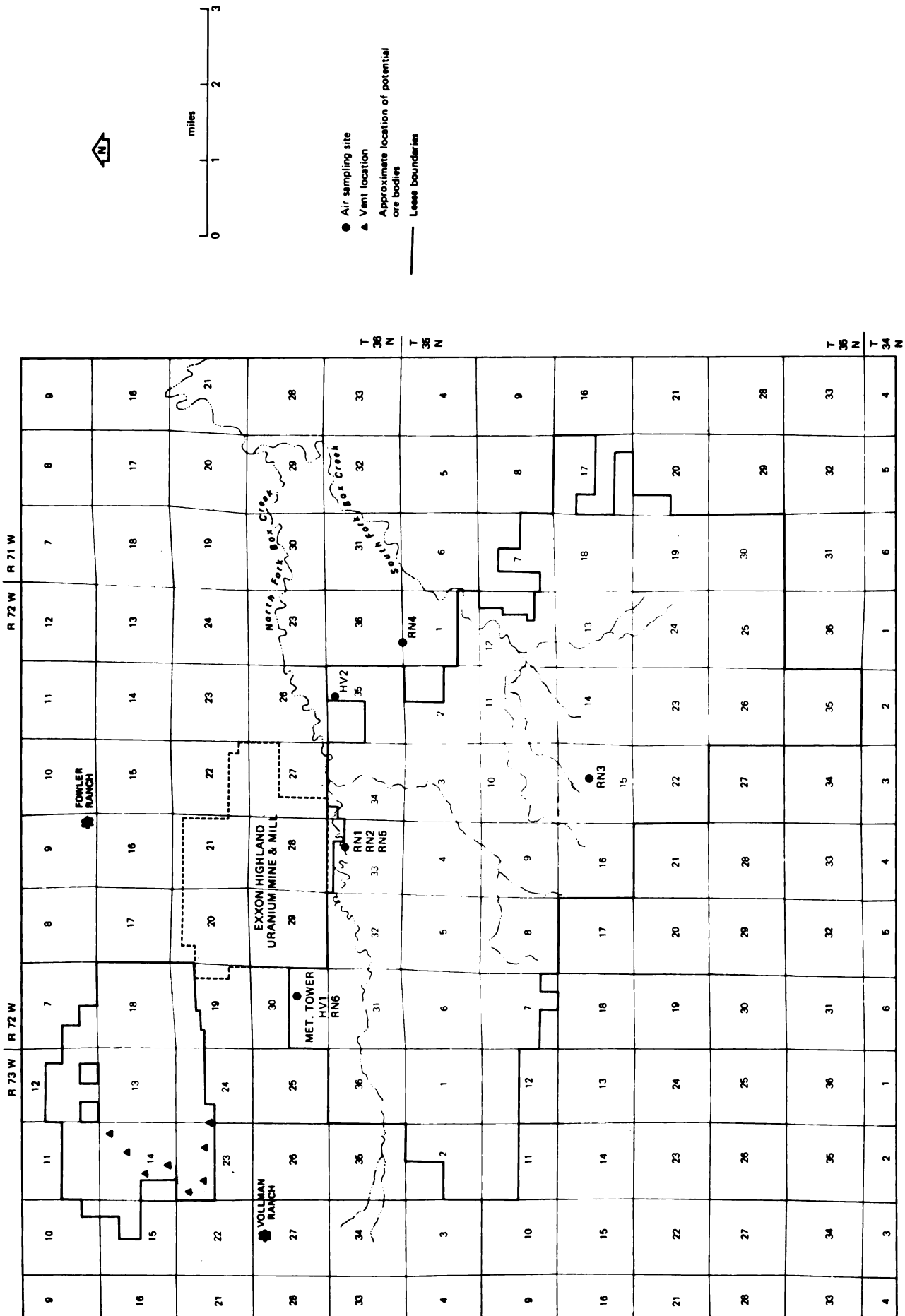
ANNUAL RELATIVE FREQUENCY DISTRIBUTION, CASPER, WYOMING, 1967-1971 (F Stability)

Direction	Wind Speed (knots)						Total
	0 - 3	4 - 6	7-10	11-16	17-21	>21	
N	0.003723	0.006919	- - -	- - -	- - -	- - -	0.010642
NNE	0.001668	0.005617	- - -	- - -	- - -	- - -	0.007286
NE	0.001431	0.003562	- - -	- - -	- - -	- - -	0.004994
ENE	0.001104	0.003562	- - -	- - -	- - -	- - -	0.004666
E	0.001608	0.003631	- - -	- - -	- - -	- - -	0.005239
ESE	0.001124	0.001987	- - -	- - -	- - -	- - -	0.003111
SE	0.000635	0.001576	- - -	- - -	- - -	- - -	0.002210
SSE	0.000583	0.000891	- - -	- - -	- - -	- - -	0.001473
S	0.001221	0.001644	- - -	- - -	- - -	- - -	0.002865
SSW	0.001124	0.001987	- - -	- - -	- - -	- - -	0.003111
SW	0.001448	0.002809	- - -	- - -	- - -	- - -	0.004257
WSW	0.002996	0.007809	- - -	- - -	- - -	- - -	0.010806
W	0.005746	0.012673	- - -	- - -	- - -	- - -	0.018419
WNW	0.002607	0.006234	- - -	- - -	- - -	- - -	0.008841
NW	0.002023	0.005754	- - -	- - -	- - -	- - -	0.007777
NNW	0.002606	0.006645	- - -	- - -	- - -	- - -	0.009250
TOTAL	0.031648	0.073298	- - -	- - -	- - -	- - -	

Relative Frequency of Occurrence of F Stability = 0.104946

Relative Frequency of Calms Distributed Above With F Stability = 0.017126





3.5-5 METEOROLOGICAL TOWER SITE, BACKGROUND AIR SAMPLING SITES, AND PROPOSED LOCATIONS OF UNDERGROUND MINE VENTS

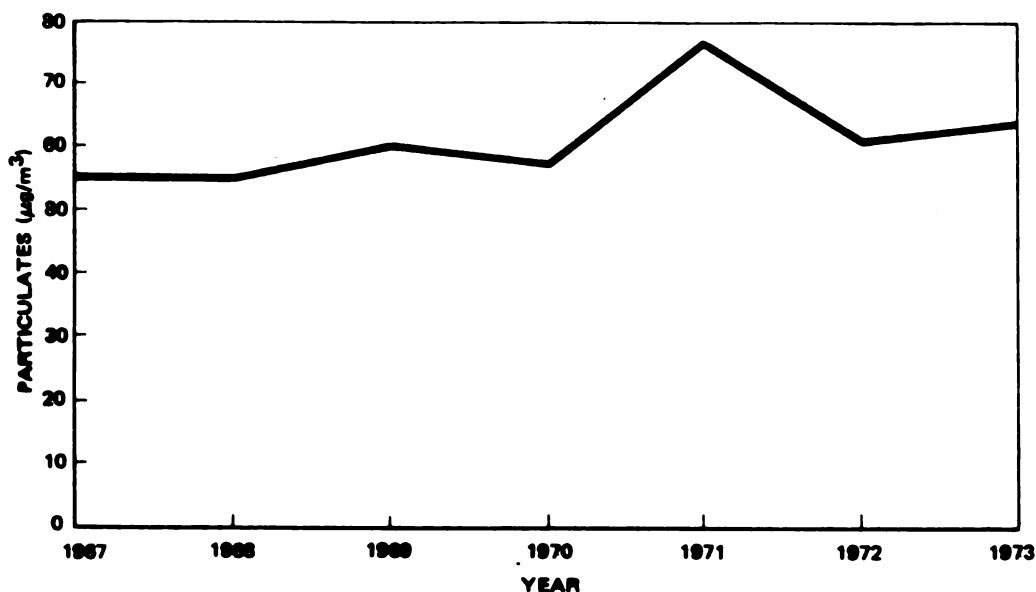


Figure 3.5-6 ANNUAL GEOMETRIC MEAN TRENDS FOR PARTICULATES AS MEASURED IN CASPER, WYOMING⁹

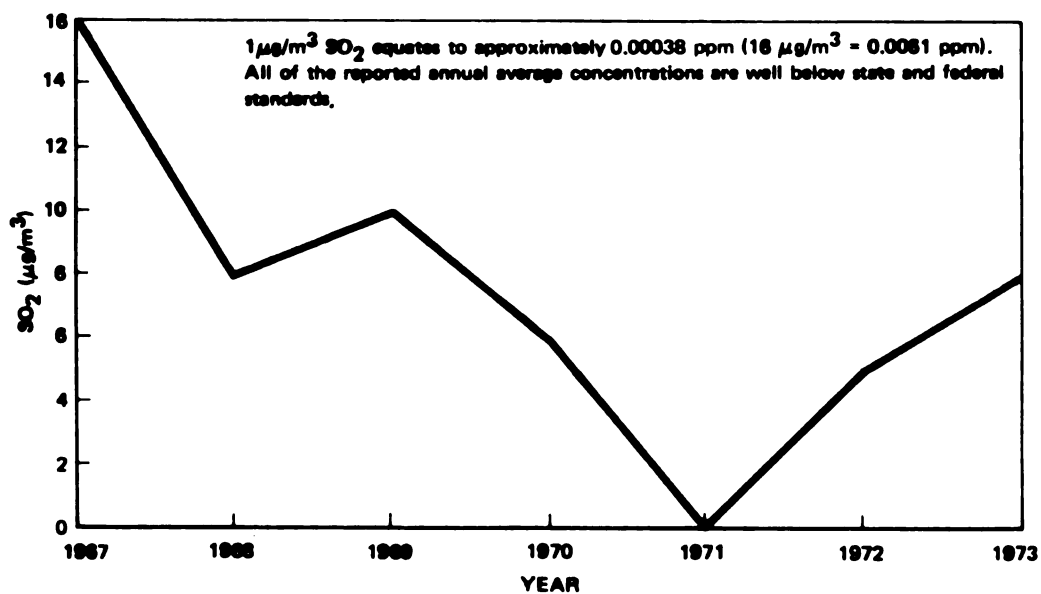


Figure 3.5-7 ANNUAL ARITHMETIC MEAN TRENDS FOR SO₂ AS MEASURED IN CASPER, WYOMING⁹

3.5 REFERENCES

1. Lowers, A. R. 1960. Climate of Wyoming. Washington, D.C.: U.S. Department of Commerce.
2. Thom, H. C. S. 1963. Tornado Probabilities. Monthly Weather Review 92:730-736.
3. Thom, H. C. S. 1968. New Distributions of Extreme Winds in the United States. Journal of the Structural Division, Proceedings of the American Society of Civil Engineer. Vo. 94 No. 7:1787-1801.
4. Hershfield, D. M. 1961. Rainfall Frequency Atlas to the United States for Durations from 30 minutes to 24 hours and Return Periods from 1 to 100 years. Technical Paper 40. Washington, D.C.: U.S. Weather Bureau.
5. Miller, J. F. 1964. Two to Ten Days Precipitation for Return Periods of 2 to 100 Years in the Contiguous United States. Technical Paper No. 49. Washington, D.C.: U.S. Weather Bureau.
6. Local Climatological Data - Summary with Comparative Data, 1973. Casper Wyoming. U.S. Department of Commerce.
7. Raabe, O. G. 1969. Concerning the Interactions that Occur Between Radon Decay Products and Aerosols. Health Physics. 17:177-185.
8. Lockhart, L. 1964. Radioactivity of the Radon-222 and Radon-220 Series in the Air at Ground Level. In Natural Radiation Environment, ed. J. A. S. Adams and W. M. Lowder. Chicago: University of Chicago Press.
9. U.S. Environmental Protection Agency, 1973, The National Air Monitoring Program: Air Quality and Emission Trends Annual Report (Vols. 1 and 2)

3.6 BIOLOGY

Information on the vegetation and wildlife on the Morton Ranch property was obtained from a survey of the literature and a field study. The field study consisted of surveys of the terrestrial vegetation and wildlife and of the aquatic organisms at eight biological sampling sites on the property.

1. Vegetation - The Morton Ranch property is located on the western edge of the North American prairie. Vegetation in that region is characterized primarily by grasses and sagebrush, with very few trees. This pattern of vegetation is largely the result of a lack of precipitation (see Section 3.5) and a high evapotranspiration rate.

Vegetation on the property consists of a variety of plant species (Table 3.6-1). Preliminary studies indicate that the terrestrial plant community on the Morton Ranch property is a sagebrush-grass association (Figure 3.6-1). The composition of this association varies from site to site, due primarily to differences in the amount of available soil moisture, the degree of adaptation of the plant species to withstand drought conditions, and the current and past grazing practices. There are at least three fairly distinct variations of the sagebrush-grass association on the Morton Ranch property: blue grama/big sagebrush; big sagebrush/crested wheatgrass/needle and threadgrass; and western wheatgrass/snakeweed.

An aquatic and a riparian community are also established on the Morton Ranch property.

Aquatic samplings of Periphyton included:

- (1) Grass-green algae of the genera Scenedesmus, Kirchneriella, and Closterium.
- (2) Diatoms of the genera Tabellaria, Diatoma, Synedra, Asterionella, Cocceneis, Rhoicosphena, Frustula, Navicula, Anomoeneis, Pinnularia, Gomphonema, Cymbella, Amphora, and Nitzschia.
- (3) Blue-green algae of the genera Agmenellum, Anabaena, and Lyngbya.

Vascular plants such as the buttercup were also collected. These aquatic plants are found along the north fork of Box Creek and around ponds in the area.

Riparian habitat is common in the low-lying areas along the north fork of Box Creek. Cordgrass and marsh species such as horsetail and rushes are prevalent. A few cottonwood trees, willow and greasewood also grow along the lower drainage.

No unique, rare, or endangered plant species were observed on the Morton Ranch property.¹

2. Wildlife - The short-grass prairie habitat of the Morton Ranch property supports a diverse fauna of big game, medium-sized and small animals, birds, reptiles, amphibians, fish, and arthropods. Several species are important to human beings as game animals, while all of the species are factors in maintaining this ecosystem.

Big Game - Pronghorn and mule deer are the two big-game species found on the property (Table 3.6-2). The pronghorn prefers the open expanses of grasslands and sagebrush common in the area and is a year-long resident of Morton Ranch. This species feeds mostly on shrubs but does eat lesser amounts of forbs and grasses. Sagebrush, the dominant shrub on the property, makes up over 75 percent of the pronghorn's diet in the winter.² Present range conditions and management policies maintain an average density of approximately five or six pronghorn per square mile in the vicinity of the ranch.³ Mule deer prefer more rugged terrain, with adequate cover, than most of the Morton Ranch property offers; consequently, they are not as abundant there as pronghorn. There is probably an average of fewer than two mule deer per square mile on the ranch.³ Mule deer rely heavily on trees and shrubs for food throughout the year, though in spring they eat more grasses and forbs than in other seasons.⁴

Medium-Sized Mammals - Medium-sized mammals expected to live on the Morton Ranch property include the black-tailed jackrabbit, white-tailed jackrabbit, desert cottontail, coyote, red fox, badger, striped skunk, and raccoon (Table 3.6-2). Medium-sized mammals are important in the food chain of the prairie ecosystem as herbivores, carnivores, or omnivores. Many of them are also useful to people as game or furbearing animals.⁵

Small Mammals - Small mammals are by far the most numerous mammals on the Morton Ranch property, and rodents are the most commonly observed small mammals (Table 3.6-2). People seldom see them because

of their normally nocturnal and burrowing behavior. Their abundance, however, makes them important as herbivores and as prey for larger, predatory mammals and for raptors. Live-trapping on the Morton Ranch property during July and August 1974 indicated that deer mice and thirteen-lined ground squirrels are the most plentiful rodents. The Wyoming pocket mouse was relatively abundant and the Ord's kangaroo rat was found in sandy habitats. The meadow vole was trapped in moist grassy areas adjacent to the north fork of Box Creek.

Bats - Bats are expected to be most active around ponds and small creeks, where they find flying insects. Although little is known about the abundance or the specific habits of bats in eastern Wyoming, it is believed that the small-footed myotis, long-legged myotis, long-eared myotis, big brown bat, hoary bat, silver-haired bat, and Townsend's big-eared bat may occasionally utilize the property; however, none were observed during the July-August 1974 survey on Morton Ranch property.

Birds - A variety of birds use the Morton Ranch property for a permanent or seasonal residence or as a temporary resting place during migration (Table 3.6-3). The birds function as herbivores, insectivores, predators, and scavengers. As such, they are an important group in maintaining stability in various food chains of the ecosystem.

Upland Game Birds - The sage grouse, and mourning doves are upland game birds that have been observed on the Morton

Ranch property. Sage grouse are relatively abundant in the area. They are extremely dependent on stands of sagebrush for food and cover, and on waterholes for drinking water. The Morton Ranch property has an abundance of both. During field surveys conducted in July and August 1974, sage grouse droppings were prevalent in some sagebrush areas. Sage grouse are the most heavily hunted upland game bird in the state.

Mourning doves, which are found throughout the property, are now considered a game species in Wyoming. Doves feed chiefly on forb and grass seeds. Mourning dove nests are constructed in the few trees along Box Creek and in sagebrush and other shrubs in places where trees are not available.

Waterfowl - Many species of waterfowl live on the property, either permanently or seasonally (Table 3.6-3). Others use it as a resting area during migratory flights over eastern Wyoming. Several ponds in low-lying areas and along the north fork of Box Creek provide suitable breeding habitat for several species of ducks, especially during years when sufficient rainfall fills many of the stock ponds. The mallard, blue-winged teal, green-winged teal, and American widgeon were observed on the ranch. Of these, the mallard is the most abundant.

Several species of shorebirds utilize the stock ponds and the areas bordering the north fork of Box Creek. The great blue heron, killdeer, lesser yellowlegs, and California gull have been observed (Table 3.6-3).

Raptors - Several raptorial birds range over the Morton Ranch property (Table 3.6-3). Although some are much more common than others, none is abundant, which is the general rule for third-order consumers.

Raptors observed on the Morton Ranch property in the July-August 1974 survey include the golden eagle, ferruginous hawk, marsh hawk, Swainson's hawk, and rough-legged hawk.

Other Birds - The short-grass prairie is suitable habitat for several species of small birds. The most common species observed on the ranch were the common raven, western kingbird, horned lark, loggerhead shrike, western meadowlark, lark bunting, vesper sparrow, McCown's longspur, and redwinged blackbird (Table 3.6-3). Most of them are seedeaters or insectivores. Their nests are usually built on the ground or in shrubs, and occasionally in trees if they are available. Most of the birds migrate from the area during the winter.

Reptiles and Amphibians - Species of reptiles and amphibians are not as numerous in eastern Wyoming as in parts of the country where winters are not so severe or where moist habitats are more common. The July-August 1974 survey noted the northern prairie lizard, sagebrush lizard, and the eastern short-horned lizard. Amphibians observed were the leopard frog and the bullfrog. The leopard frog is by far the most commonly observed amphibian in the area and is found around most ponds during the spring and summer.

Fish - Three species of fish were found in ponds associated with the north fork of Box Creek (Table 3.6-4). The fathead minnow was abundant in both ponds sampled. The flathead chub and the white sucker were found in one pond but in much smaller numbers. The stock ponds and ponds associated with the intermittent north fork of Box Creek are not acceptable habitats for any species of game fish because many of the ponds are dry at times during the year. Those that do not dry up are likely to be eutrophic; therefore, undesirable as aquatic habitat by game fish.

Arthropods - Arthropods are by far the most abundant animals, in terms of both species and total numbers, on the Morton Ranch property.

Grasshoppers, thrips, leaf bugs, seed bugs, treehoppers, froghoppers, leafhoppers, aphids, leaf beetles, snout beetles, and plant mites are examples of the many arthropod herbivores that live abundantly in grasslands. Examples of predatory arthropods that inhabit the Morton Ranch property include dragonflies, praying mantises, assassin bugs, ground beetles, ladybird beetles, robber flies, spider wasps, and wolf spiders. Arthropods functioning as scavengers include earwigs, hister beetles, carrion beetles, dermestid beetles, dung beetles, blowflies, and flesh flies. Many arthropods also occur in the riparian and aquatic habitats of Morton Ranch (Table 3.6-5).

Endangered Wildlife - Four species whose ranges include Wyoming are listed as endangered by the U. S. Fish and Wildlife Service.⁶ The possibility exists that two of these, the American

peregrine falcon and the black-footed ferret, may occur from time to time on the Morton Ranch property.

A survey of the peregrine falcon in 1964/65 indicated that approximately 25 breeding pairs occurred in Colorado and Wyoming.⁷ Cliffs seem to be an important component of their habitat. Since there are no pronounced cliffs or established perch sites on the Morton Ranch property, it is highly doubtful that American peregrine falcons would nest in the area.

The black-footed ferret is closely associated with prairie dogs, its main source of food. The prairie dog has not been observed and is not expected to occur on the Morton Ranch. The black-footed ferret is extremely rare, even in areas inhabited by prairie dogs and thus the likelihood of their inhabiting the Morton Ranch property is extremely small.

Populations of two other species that may live in the vicinity of the Morton Ranch property are considered threatened. These include the prairie falcon and the spotted bat.⁸

Prairie falcons prefer cliffs for nesting and therefore are not expected to breed on the Morton Ranch property.

The probability is extremely low that spotted bats would be found on the ranch since their main range is in the south and west of the state.

The ferruginous hawk and the burrowing owl are listed as "status undetermined" by the U. S. Bureau of Sports Fisheries and Wildlife.⁹ The ferruginous hawk was observed over the Morton Ranch property in 1974 during field surveys. The burrowing owl, which is listed as rare and endangered by the state of Wyoming,¹⁰ is locally common in many areas of the West. Although none have been observed on the property during field surveys, burrowing owls may possibly inhabit the area from time to time.

Wyoming also designates the western smooth green snake as rare and endangered. The range of that snake may include the Morton Ranch property, although it was not observed during field surveys.

The northern swift fox (locally called the kit fox) is considered rare by the State of Wyoming and may occasionally inhabit the Morton Ranch property.

TABLE 3.6-1

PLANTS OBSERVED DURING FIELD STUDIES ON THE MORTON RANCH
PROPERTY

Scientific Name	Common Name
TREES, SHRUBS, AND SUCCULENTS	
<u>Artemisia cana</u>	Silver sage
<u>Artemisia tridentata</u>	Big sagebrush
<u>Chrysothamnus viscidiflorus</u>	Rabbitbrush
<u>Eurotia lanata</u>	Winter fat
<u>Mammillaris sp.</u>	Pincushion cactus
<u>Opuntia polyacantha</u>	Prickly pear
<u>Populus spp.</u>	Cottonwood
<u>Sarcobates vermiculatus</u>	Greasewood
<u>Yucca glauca</u>	Spanish bayonet
FORBS	
<u>Achillea lanulosa</u>	Yarrow
<u>Allium sp.</u>	Onion
<u>Antennaria sp.</u>	Pussy-toes
<u>Artemisia frigida</u>	Fringed sage
<u>Astragalus sp.</u>	Milkvetch
<u>Castilleja coccinea</u>	Indian paintbrush
<u>Cleome serrulata</u>	Rocky Mountain bee plant
<u>Equisetum sp.</u>	Horsetail
<u>Eriogonum sp.</u>	Eriogonum - perennial buckwheat
<u>Gutierrezia sarothrae</u>	Snakeweed
<u>Helianthus petiolaris</u>	Prairie sunflower
<u>Hymenopappus sp.</u>	Hymenopappus
<u>c.f. Lactuca pulchella</u>	Blue lettuce
<u>Lepidium spp.</u>	Pepperweed
<u>Melilotus spp.</u>	Prairie clover
<u>Mentha arvensis</u>	Mint

TABLE 3.6-1 (Continued)

Scientific Name	Common Name
FORBS (continued)	
<u>Mirabilis linearis</u>	Narrow leaved four-o'clock
<u>Phlox hoodii</u>	Hood's phlox
<u>Rudbeckia c.f. occidentalis</u>	Coneflower
<u>Rumex crispus</u>	Dock
<u>Sagittaria cuneata</u>	Arrowhead
<u>Salsola kali</u>	Russian thistle
<u>Taraxacum officianale</u>	Dandelion
<u>c.f. Verbena bracteata</u>	Bracted vervain
GRAMINOIDS	
<u>Agropyron cristatum</u>	Crested wheatgrass
<u>Agropyron smithii</u>	Western wheatgrass
<u>Agropyron spicatum</u>	Bearded blue-bunch wheatgrass
<u>Aristida fendleriana</u>	Fendler three-awn
<u>Boutelous gracilis</u>	Blue grama
<u>Bromus tectorum</u>	Cheatgrass
<u>Calamovilfa longifolia</u>	Prairie sandreed
<u>Carex filifolia</u>	Threadleaf sedge
<u>Juncus balticus</u>	Baltic rush
<u>Juncus torreyi</u>	Torrey's rush
<u>Keoheria cristata</u>	Junegrass
<u>Muhlenbergia asperifolia</u>	Scratchgrass
<u>Oryzopsis hymenoides</u>	Indian rice grass
<u>Poa secunda</u>	Sandberg's bluegrass
<u>Poa sp.</u>	Dropseed
<u>Sitanion hystric</u>	Squarreltail grass
<u>Spartina pectinata</u>	Prairie cordgrass
<u>Stipa comata</u>	Needle-and-thread grass

TABLE 3.6-2

MAMMALS OBSERVED ON THE MORTON RANCH PROPERTY
DURING THE JULY-AUGUST, 1974 SURVEY

Scientific Name	Common Name
BIG GAME	
<u>Antilocapra americana</u>	Pronghorn
<u>Odocoileus nemionus</u>	Mule deer
MEDIUM-SIZED MAMMALS	
<u>Mephitis mephitis</u>	Striped skunk
SMALL MAMMALS	
<u>Dipodomys ordii</u>	Ord's kangaroo rat
<u>Microtus ochrogaster</u>	Prairie vole
<u>Microtus pennsylvanicus</u>	Meadow vole
<u>Onychomys leucogaster</u>	Northern grasshopper mouse
<u>Perognathus fasciatus</u>	Wyoming pocket mouse
<u>Peromyscus maniculatus</u>	Deer mouse
<u>Reithrodontomys megalotis</u>	Western harvest mouse
<u>Spermophilus tridecemlineatus</u>	Thirteen-lined ground squirrel

TABLE 3.6-3

BIRDS OBSERVED ON THE MORTON RANCH PROPERTY
DURING THE JULY-AUGUST, 1974 SURVEY

Scientific Name	Common Name
UPLAND GAME BIRDS	
<u>Centrocercus urophasianus</u>	Sage grouse
<u>Zenaidura macroura</u>	Mourning dove
WATERFOWL	
<u>Anas carolinensis</u>	Green-winged teal
<u>Anas discors</u>	Blue-winged teal
<u>Anas platyrhynchos</u>	Mallard
<u>Mareca americana</u>	American widgeon
SHOREBIRDS	
<u>Ardea herodias</u>	Great blue heron
<u>Capella gallinago</u>	Common snipe
<u>Charadrius vociferus</u>	Killdeer
<u>Larus californicus</u>	California gull
<u>Totanus flavipes</u>	Lesser yellowlegs
RAPTORS	
<u>Aquila chrysaetos</u>	Golden eagle
<u>Buteo lagopus</u>	Rough legged hawk
<u>Buteo regalis</u>	Ferruginous hawk
<u>Buteo swainsoni</u>	Swainson's hawk
<u>Circus cyaneus</u>	Marsh hawk
OTHER BIRDS	
<u>Agelaius phoeniceus</u>	Redwinged blackbird
<u>Alauda arvensis</u>	Skylark
<u>Calamospize melanocorys</u>	Lark bunting
<u>Calcarius lapponicus</u>	Lapland longspur

Table 3.6-3 (Continued)

Scientific Name	Common Name
<u>Chordeiles minor</u>	Common nighthawk
<u>Corvus corax</u>	Common raven
<u>Eremophila alpestris</u>	Horned lark
<u>Lanius ludovicianus</u>	Loggerhead shrike
<u>Molothrus ater</u>	Brown-headed cowbird
<u>Passerculus sandwichensis</u>	Savannah sparrow
<u>Petrochelidon pyrrhonota</u>	Cliff swallow
<u>Pica pica</u>	Black-billed magpie
<u>Poocetes gramineus</u>	Vesper sparrow
<u>Rhynchophanes mccownii</u>	McCown's longspur
<u>Sturnella neglecta</u>	Western meadowlark
<u>Tyrannus verticalis</u>	Western kingbird

TABLE 3.6-4

ABUNDANCE AND SPECIES OF FISH COLLECTED ON THE MORTON
RANCH PROPERTY

Scientific Name	Common Name	Study Site 5	Study Site 6
Family <u>Cyprinidae</u>	Minnows and carps		
<u>Pimephales promelas</u>	Fathead minnow	346	111
<u>Hybopsis gracilis</u>	Flathead chub	-	9
Family <u>Catostomidae</u>	Suckers		
<u>Catostomus</u> <u>commersoni</u>	White sucker	-	14

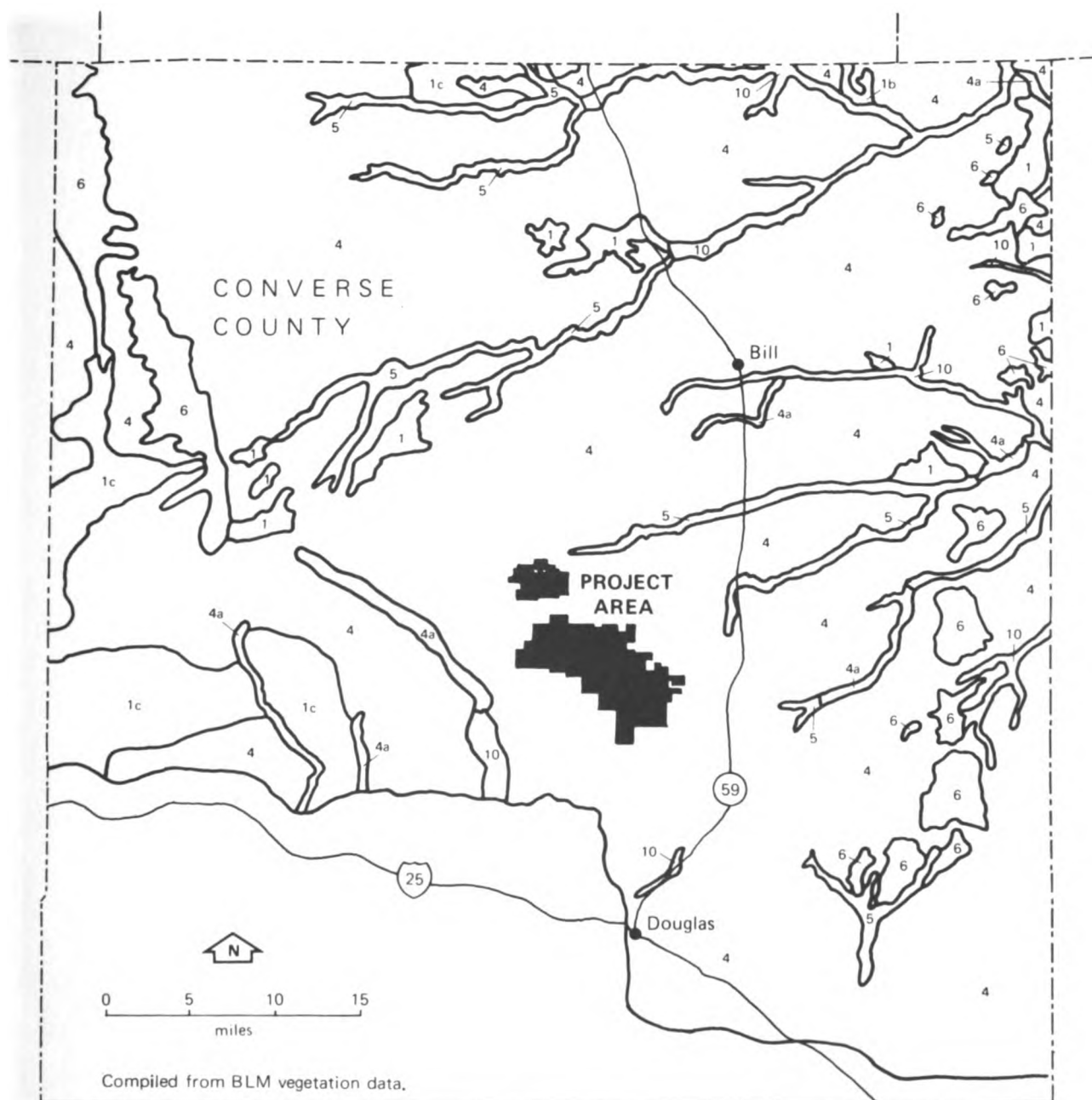
TABLE 3.6-5

NUMBER OF AQUATIC ORGANISMS COLLECTED AT EACH SAMPLE SITE*

Order and Class	Common Name	Study Site 5			Study Site 6		
		1	2	3	1	2	3
Arthropods							
Insecta							
Diptera	True flies	45	13	5	12	29	30
Ephemeroptera	Mayflies	6	2	2	4	2	7
Hemiptera	True bugs	2	-	-	-	-	-
Odonata	Damselflies, Dragonflies	1	1	3	-	-	4
Trichoptera	Caddisflies	2	-	-	-	6	-
Crustacea							
Amphipoda	Scuds	10	8	-	-	2	3
Hydracarina	Water mites	-	-	1	-	-	1
Annelida							
Oligochaeta	Aquatic earthworms	-	-	-	2	9	-
Hirudinea	Leeches	3	-	-	-	-	-
Mollusca							
Gastropoda	Snails	x**	x	x	x	x	x
Pelecypoda	Clams	x	x	x	x	x	x

* Number of organisms per 225 cm.²

** Denotes the organism was present but not counted.



1	Dry Grassland (Agsm - Dist)	4	Big Sagebrush (Artr)	6	Ponderosa Pine Forest (Pipo)
1b	Scoria Grassland (Agsp)	4a	Silver Sagebrush (Arca)	10	Broadleaf Forest (Posa)
1c	Sandhills Grassland (Cavi)	5	Greasewood (Save)		

3.6-1 VEGETATION TYPES OF NORTHERN CONVERSE COUNTY, WYOMING

3.6 REFERENCES

1. Smithsonian Institution. 1975. Report on Endangered and Threatened Plant Species of the United States. U. S. Government Printing Office. Serial No. 94-A.
2. Bayless, S. R. 1969. Winter Food Habits, Range Use, and Home Range of Antelope in Montana. Journal of Range Management 33:539-551
3. Pate, L. 1972. A Brief Inventory of the Wildlife Resources in the Highland Flats Area of Converse County. In Environmental Statement, the Highland Uranium Mill. U. S. Atomic Energy Commission, March 1973. Docket No. 40-8102.
4. Kufield, R. C.; O. C. Wallmo; and C. Feddema. 1973. Foods of the Rocky Mountain Mule Deer. Forest Service Research Paper RM-111. Washington, D.C.: U. S. Department of Agriculture.
5. Wyoming Game and Fish Commission. 1972. Annual Report of Big Game Harvest. 1971. Cheyenne.
6. Bureau of Sport Fisheries and Wildlife. 1973. Threatened Wildlife of the United States. Resource Publication 114. Washington, D. C.: U. S. Department of the Interior.
7. Enderson, J. H. 1969. Population Trends Among Peregrine Falcon Populations, ed. J. J. Hickey. Milwaukee: University of Wisconsin Press.
8. Bureau of Land Management. 1974. Habitat Management Series for Endangered Species. Report No. 8, Prairie Falcon; Report No. 4, Spotted Bat. Washington, D. C. (USDI).
9. Bureau of Sport Fisheries and Wildlife. 1973. Threatened Wildlife of the United States. Resource Publication 114. Washington, D. C. (USDI).
10. Wyoming Game and Fish Commission. Undated. Wyoming's Rare and Endangered Wildlife. Cheyenne.

3.7 HISTORICAL AND ARCHAEOLOGICAL SIGNIFICANCE

History - There are no sites on or within the immediate vicinity of the Morton Ranch property which are listed in the National Register of Historic Places. In response to an inquiry, the chief of the Wyoming Historic Division confirms this and notes that to their knowledge, no site or structure presently being nominated, being considered for nomination or listed in the state inventory for possible future nomination would be affected by this project. TVA is in the process of further investigation to identify the existence of potentially significant historic sites.

Archaeology - An archaeological survey of the area that would be affected by the proposed mining project was conducted by personnel from the University of Wyoming anthropology department, under the direction of George M. Zeimens, assistant state archaeologist. One significant find was uncovered during the survey. It is located approximately two miles from any currently planned mining activities. The site appears to be a large campsite, containing information on such activities as stone-tool working and manufacture, food procurement, and food preparation. As many as three, and possibly four, cultural periods, ranging in date from 2000 B.C. to the historic period, may be represented at the site. For this reason the Wyoming state archaeologist considers this find worthy of nomination to the National Register of Historic Places and indicates it has already been placed on the Wyoming Register of Archaeological Sites.

3.8 SOCIOECONOMY

This section discusses past and present socioeconomic conditions and offers some considerations to future development of Converse County as assessed by the State of Wyoming.¹

1. Population and Income - The population of Converse County as well as the incorporated areas of Douglas and Glenrock, have experienced some marked fluctuations since 1940 (Table 3.8-1). Population decreases in the 1940's and 1960's are attributed to declining employment opportunities in the agricultural sector. Since the 1970 Census, additional data has shown the total population in the county increased more than 14 percent between 1970 and 1973. This reverse trend in population decline is associated primarily with increased activities involving mineral extractions.

Population density in Converse County in 1970 averaged 1.4 persons per square mile compared to the State average of 3.4. Density in the vicinity of the Morton Ranch property is estimated between 0.1 and 0.2 persons per square mile.

Population projections for Converse County, developed by Federal and State agencies and academic institutions are shown in Table 3.8-2. These projections have allowed for various assumptions regarding future development. For this discussion, Alternative Future 1, shown in Table 3.8-2, is used because this assumption takes into account the energy development projects for firms which had signed (as of May, 1974) or were expected to sign contracts, and for publicly announced projects. Population changes for the incorporated areas of Converse County, associated with Alternative Future 1 are as follows:¹

	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>
Douglas	232	1801	2262	2262
Glenrock	55	653	728	728

Personal income (total and per capita) accruing to Converse County residents has increased annually since 1950 (Table 3.8-3). Total personal income rose by almost 16 percent during 1971, as did per capita income. Major sources of personal income in 1975 included agriculture (23.9 percent); transportation, communication, and public utilities (19.6 percent); and contract construction (17.7 percent).

Income data gathered during the 1970 Census of Population showed that Converse County families had a mean income of \$9191, and a median income of \$8947. Statewide statistics were higher for mean income (\$10,127) but slightly lower for median income (\$8943).

2. Community Infrastructure - Project employees and project-related secondary employment are expected to be distributed principally in the Douglas and Glenrock communities; therefore, existing community infrastructure is considered for these areas.

Water - Douglas currently gets most of its potable water from natural springs having a capacity of approximately 1150 gallons per minute (gal./min.). When demand exceeds spring capacity, up to 1000 gal./min. may be drawn by pumps from the North Platte River. Existing storage capacity totals 3 million gallons. Average per capita consumption is about 200 gallons per day (gal./day), or 431 gal./min. total. Peak usage is about 550 gal./day per capita, or 1300 gal./min. total.

Glenrock receives its potable water from six wells. System transmission capacity is presently 600 gal./min.; existing storage capacity totals 150,000 gal. Daily peak demand reaches 200,000 gal. The municipal water systems presently has no excess capacity.

Sewer/Solid Waste - Primary sewage treatment in Douglas is provided by a lagoon two-pond (cell) system with a capacity of 450,000 gal./day. Secondary treatment will be required by 1977 to comply with EPA specifications. Current best estimates indicate that sewage treatment facilities are at or very near capacity.

Glenrock also has a primary sewage treatment facility with two small lagoon cells. An additional cell is currently required, since existing cells cannot be expanded and the system is operating at capacity.

Both communities use the landfill disposal system for solid waste.

Recreation - Converse County provides numerous opportunities for outdoor recreation. The hunting of big game and upland game is a major recreational activity, particularly in northern Converse County. Parks and other recreational facilities are listed in Table 3.8-4. The city-county parks and playgrounds have facilities for picnicking, baseball, and children's recreation, in addition to the Douglas Golf Course and the Jackalope Plunge (a municipal swimming pool).

Schools - Douglas Unified School District No. 1 and Glenrock Unified School District No. 2 serve the educational needs of Converse County. Combined enrollment in fall 1973 was 1783 students.

Douglas Unified School District No. 1, which covers the eastern two-thirds of the county, had a fall 1973 enrollment of 1104 students, an average student-teacher ratio of 15.5 to 1, and an inventory of nine elementary schools and one junior-senior high school. Maximum enrollment capacity was set at 1320 students. Four of the schools (grades K-8, total capacity of 60) are located in northern Converse County.

Glenrock Unified School District No. 2, which covers the rest of the county, has four elementary schools and one junior-senior high school. Total fall 1973 enrollment was 679, with an average student-teacher ratio of 21.4 to 1. School facilities had a maximum enrollment capacity of 801, and the utilization rate was 85 percent. Future construction plans call for additional capacity for 325 students.

Health Services - The Memorial Hospital of Converse County, in Douglas, currently has a bed capacity of 32; it had 587 adult admissions in 1973, which constituted a 22 percent occupancy rate.

Three general practitioners currently serve Converse County, two in Douglas and one in Glenrock. Surgery is performed in Casper, since Converse County does not have a resident surgeon.

The Wyoming Counseling Service provides Converse and Niobrara counties with mental health counseling.

Michael Manor, a 59-bed nursing care facility is located in Douglas. This private nursing home was filled to 93 percent of its capacity during 1973.

3. Housing - The 1970 U. S. Census of Housing provides the most comprehensive inventory available of housing conditions within Converse County. At the time of the 1970 Census, a total population of 5932 persons occupied 2247 year-round housing units; of these, 1369 units were owner-occupied and 589 were rented. A total of 289 units were vacant, representing a vacancy rate of 12.9 percent. The year-round housing units included single family dwellings, multi-family dwellings, and mobile homes. Some of these units, mostly in the rural area, lacked some or all plumbing facilities.

In the 1970 Census, Douglas was classified as the only urban area within Converse County; Glenrock data being included in the rural category.

The median housing value, both urban and rural, was \$15,100; which was \$300 less than the State median. Urban housing values tended to be higher than those in rural areas.

4. Regional Economic Activity - Employment trends provide an indication of the level and components of economic activity within a region. Because the proposed project will affect employment primarily within Converse County, employment data for only that county are presented in Table 3.8-5.

Agriculture employment has declined since 1965 but still remains a major employment sector in Converse County. Over this same period,

employment has gained in transportation, communications, and utilities; and mining. The total labor force decreased about 6 percent between 1965 and 1970, while in the period 1970-1972 the total labor forces expanded 18.5 percent, with significant employment gains in mining; construction; and transportation, communications and utilities.

Employment projections developed for Converse County¹, corresponding with the population projections previously discussed, show significant future changes. These postulated employment changes show incremental fluctuations as follows:

<u>Year</u>	<u>Implied Employment Change</u>
1975	4038
1980	3262
1985	3825
1990	3825

Economic Sectors - Significant economic sectors within Converse County are agriculture, trade, services, and mineral extraction, the basic economic sector being agriculture. Statistics for 1969 showed the county with a total land area of approximately 2.74 million acres, with 2.56 million acres of the total in farms (93.3 percent). The value of all farm products was \$9.1 million, an 81 percent increase over the 1964 total (\$5.0 million). Livestock and livestock products were valued at \$8.8 million (96.5 percent of the total value).

Productivity, as measured by total output for 1974, increased over 1970 in beef cattle, dairy cows, hogs, hay, and dry beans. All other categories declined in total output. Converse County produces a significant portion of the state total in stock sheep, cows, cattle, and oats.

The 1972 Census of Wholesale Trade (USDC) report 10 wholesale establishments within Converse County having sales of \$7.9 million. The state had 792 wholesale establishments with \$653.1 million in sales.

Federal government statistics for retail trade within Converse County (1972) showed 114 retail establishments with sales exceeding \$12.6 million. Most of these establishments (73) were located within Douglas and generated a sales volume exceeding \$9.4 million. Food stores produced the greatest dollar volume of sales (\$3.1 million), while automotive dealers generated sales amounting to \$2.3 million.

Selected Service Industries - Converse County contained 75 selected service establishments in 1972. Total receipts were about \$1.5 million. Of the total, Douglas supported 58 establishments which generated receipts of \$1.2 million.

Resource Extraction - Resources extracted in Converse County include coal, uranium, oil, and natural gas. There are two operating coal mines in the county. A uranium mine and mill, located north of Douglas, processes 3400 tons of uranium ore per day. Producing oil fields are located in the Glenrock area, while natural gas is extracted from deposits in the Shawnee area, which is approximately 21 miles east of Douglas.

5. Public Finance - Expenditures by the governments of Converse County and Douglas for fiscal 1972-73 are outlined in Table 3.8-6. Education accounts for nearly one half of the total.

Revenues by source (fiscal 1972-73) are listed in Table 3.8-7. Property taxes generated more than 75 percent of total revenues.

Total assessed valuation of real and personal property within Converse County has increased sharply since 1970, as shown below:

<u>Year</u>	<u>Total Assessed Valuation (Converse County)</u>
1970	\$52,755,197
1973	\$72,236,561
1974	\$84,904,679

Table 3.8-1

HISTORICAL POPULATION: CONVERSE COUNTY AND ITS MUNICIPALITIES

Year	Converse County	Douglas	Glenrock
1940 ^a	6631	2205	1014
1950 ^a	5933	2544	1110
1960 ^a	6366	2822	1584
1970 ^a	5938	2677	1515
1972 ^b	6700	NA	NA
1973 ^b	6800	NA	NA
1974 ^c	7100	4800	NA

^aU.S. Census of Population.

^bEstimated by U.S. Department of Commerce.

^cEstimated by Wyoming Department of Economic Planning and Development (DEPAD).

Table 3.8-2

POPULATION PROJECTIONS: CONVERSE COUNTY

Source	1977	1978	1979	1980	1985	1990	2000
Bureau of Reclamation							
Primary Assumptions				11,000			18,800
Alternative Assumptions				10,500			15,400
Wyoming Department of Economic Planning and Development ^a							
Alternative Future I	14,485	18,862	21,037	21,037	16,662	16,662	
Alternative Future II	14,954	19,331	21,506	17,525	18,069	18,150	
Alternative Future III	15,110	19,487	21,662	17,681	19,225	19,319	
U.S. Department of the Interior (1974) ^b		13,200		13,200	14,900	15,200	
Water Resources Research Institute, ^b University of Wyoming							
Scenario I				11,280	12,110		11,730
Scenario II				12,690	16,970		16,810
Scenario II-A				15,350	17,760		18,510
Scenario III				12,800	17,490		22,120

^a Assumes development of both coal and uranium.^b Assumes coal development only.

Table 3.8-3

PERSONAL INCOME: CONVERSE COUNTY²

Year	Total (\$ million)	Per Capita
1950	8.7	\$1467
1959	15.4	\$2494
1962	16.6	\$2869
1969	21.7	\$3706
1970	23.2	\$3,977
1971	29.2	\$3,968
1972	33.8	\$4,644

Table 3.8-4

OUTDOOR RECREATION FACILITIES: CONVERSE COUNTY AND VICINITY³

Facility	Acres
City - Douglas and Glenrock	
Douglas Baseball Park	9
Douglas Golf Course	30
Douglas Riverside Park	3
Douglas Washington Park	9
Glenrock City Park	10
Jackalope Plunge (Douglas)	3
County	
Ayers Natural Bridge (12 miles west of Douglas -U.S. I-25)	14
Converse County Park (9 miles S/SE of Glenrock)	2500
State	
Fort Fetterman Historic Site (Orpha)	60
Wyoming State Fair Grounds (Casper)	109
National	
Thunder Basin National Grasslands (North of Morton Ranch Property)	185,708

Table 3.8-5

EMPLOYMENT DATA FOR CONVERSE COUNTY⁴

	1965	1970	1971	1972 ^a
Total Work Force	2770	2600	3070	3080
Unemployed	90	110	100	120
Unemployment Rate	3.2%	4.2%	3.3%	3.9%
U.I.-Covered Employment^b	1030	1090	1480	1540
Manufacturing	50	20	20	20
Nonmanufacturing	980	1070	1460	1520
Agriculture	20	20	30	25
Mining	80	155	230	240
Transportation, Communications, and Utilities	190	210	250	350
Construction	220	170	390	345
Trade	330	330	360	350
Finance, Insurance, and Real Estate	40	55	50	60
Services	100	130	150	150
Government	0	0	0	0
Noncovered Employment^c				
Nonagricultural				
Nonprofit Institutions	30	10	10	30
Domestic	70	50	60	60
Self-Employed and Unpaid Family	440	290	360	350
Federal Government	70	50	60	60
Railroads	10	10	10	10 ^d
State and Local Governments	400	460	480	410 ^d
Agricultural				
Wage and Salary Workers	240	190	180	280 ^d
Self-Employed and Unpaid Family	390	340	330	290

^aYear-to-year data are not comparable (specifically in Services and in State and Local Government categories) due to the inclusion of nonprofit and reimbursable employers and workers in covered employment beginning January 1, 1972.

^bEligible for unemployment insurance benefits.

^cIneligible for unemployment benefits.

^d1972 data may not be comparable to previous years due to benchmark revisions based on 1970 census information.

Table 3.8-6

EXPENDITURES BY FUNCTION: CONVERSE COUNTY, FISCAL 1972-73⁵

Function	Converse County	City of Douglas*	School District No. 1	Special Districts	County Funds	Total
General Government	204,712.00	17,900.00	---	---	---	222,612.00
Police	52,691.00	65,000.00	---	---	---	117,691.00
Fire	---	7,500.00	---	23,847.50 ^b	---	31,347.50
Health	1,200.00	2,000.00	---	96,697.00 ^b	240,301.80 ^c	340,198.80
Roads, Airports	264,524.00	{ 99,000.00	---	---	80,321.69 ^d	443,845.69
Sanitation	---	---	---	---	---	---
Water, Sewer	1,885.00	142,367.50 ^e	---	---	---	144,252.50
Parks, Recreation	14,929.00	30,000.00	---	---	9,541.49 ^f	54,470.49
Library	---	---	---	---	50,171.06 ^g	50,171.06
Education	---	---	1,371,737.73	---	---	1,371,737.73
Agriculture	10,000.00	---	---	20,399.50 ^b	---	30,399.50
Bonds, Interest	6,007.00	29,500.00	---	---	---	35,507.00
Revenue Sharing	2,400.00	---	---	---	---	2,400.00
Cemetery	---	19,500.00	---	---	---	19,500.00
Power	---	15,500.00	---	---	---	15,500.00
Totals	558,348.00	428,267.50	1,371,737.73	140,944.00	380,336.04	2,879,633.27

^aBased on 1972-73 Douglas Annual Appropriation Bill.^bExpenditures on Predatory Animal Fund not included.^cEstimated on basis of revenues, average for 1972-73.^dEstimated on basis of average 1972-73 tax levy (MTPA): 1972, \$113,369.22; 1973, \$165,855.14 for county hospital; plus county welfare/health: 1972, \$93,024.40; 1973, \$108,354.84.^eEstimated on basis of average 1972-73 tax levy (MTPA): County road/bridge fund, 1972, \$39,936.10; 1973, \$120,707.29.^fIncludes: payment of bonds and interest on water and sewer bonds (\$83,867.50), water (\$50,000), sewer (\$8500).^gEstimated on basis of average 1972-73 tax levy (MTPA): County parks/recreation, 1972, \$5,069.08; 1973, \$14,013.89.^hEstimated on basis of average 1972-73 tax levy (MTPA): County library, 1972, \$44,936.68; 1973, \$55,405.55.

Table 3.8-7

REVENUES BY SOURCE: CONVERSE COUNTY, FSICAL 1972-73⁵

Source	Converse County ^a	Douglas	School District No. 1	Special Districts	Totals
Taxes					
Property	706,491.06 ^b	115,018.00 ^c	1,369,576.90 ^d	140,944.00 ^e	2,332,029.96
Gasoline Tax	99,763.55	35,000.00	---	---	134,763.55
Forest Reserve Fund	4,501.49	---	---	---	4,501.49
Municipalities Sales Tax	---	25,000.00	---	---	25,000.00
Misc. Road & Bridge	15,633.84	---	---	---	15,633.84
Cigarette Tax	1,442.26	30,000.00	---	---	31,442.26
Use Tax	---	---	---	---	---
Licenses, Permits	63,227.41	9,830.00	---	---	73,057.41
Fines, Penalties	380.91	10,000.00	---	---	10,380.91
Use of Property, Money	14,843.30	7,800.00	---	---	22,643.30
Other Gov't Agencies	3,945.00	---	95,745.55	---	99,690.55
Current Services	---	98,900.00 ^f	---	---	98,900.00
Other Revenues	---	31,000.00	40,671.89	---	71,671.89
Revenue Sharing	162,147.00	---	---	---	162,147.00
Totals	1,072,375.82	362,548.00	1,505,994.34	140,944.00	3,081,862.16

^aRevenues to Predatory Animal Fund not included.^bNet of county school taxes, average 1972-73 calendar years, from MTPA.^cAverage 1972-73 calendar years, MTPA.^dIncludes district levy (\$802,737.65) and county levy (\$566,839.33).^eAverage 1972-73 calendar years: Weed and pest (\$20,399.50), fire district (\$23,847.50), hospital (\$96,697.00).^fIncludes charges for sanitation services (\$40,000.00) and water receipts (\$50,000.00).

3.8 REFERENCES

1. Wyoming Department of Economic Planning and Development. 1974. Coal and Uranium Development of the Powder River Basin - an impact assessment.
2. Bureau of Economic Analysis, Regional Economic Information System. August, 1974.
3. Douglas and Glenrock Chambers of Commerce. 1974. Community Profile.

Wyoming Recreation Commission. 1973. An Outdoor Recreation Plan for Wyoming.
4. Wyoming Employment Security Commission. 1974. Employment Data for Converse County.
5. Wirth-Berger Associates and Intermountain Planners. 1974. Capital Facilities Studies - Powder River Basin.

3.9 OTHER

1. Noise - A survey of onsite background noise was performed October 14, 1974, with measurements being made at sample sites RN1 through RN6 (Figure 3.5-5). A windscreen was used, and a sound level meter was placed in the "slow response" mode. Sound-level meter calibration was checked before each measurement. The results are presented in Table 3.9-1.

The A-scale measurements were low and fairly consistent from one sample site to another, ranging between 27 and 38 dB, but B- and C-scale readings varied from site to site. By switching from C to B to A scales, measurements became increasingly weighted toward higher-frequency noise. Differences observed between A-, B-, and C-scale noise levels indicate the existence of lower-frequency noise at each site, and increases in B- and C-scale (especially C) noise levels from the first to the last measurement indicates an increase in lower-frequency noise which can be attributed to an increase in surface wind speed during sampling.

The noise measurements allow an estimate that the normal background equivalent sound level, $L_{eq}(24)^1$, is approximately 30 dB and the day-night weighted equivalent sound level, L_{dn} , is approximately 37 dB. The L_{dn} is defined as the A-weighted average sound level in decibels during a 24-hour period, with a 10 dB weighting applied to nighttime (10 p.m. to 7 a.m.) sound levels.

Ambient noise levels appear to be established by natural sources over most of the site. Nearby mining and milling activities

should not be considered significant sources of noise, except possibly during blasting, which occurs infrequently, and which did not occur during the background noise measurement program.

The natural background level obviously increases during high winds and thunderstorms. Thunderstorms can have noise levels of up to 120 dB(A) for very short periods of time. Natural disturbances of the background noise level can also be caused by wildlife.

2. Radiological Background - Baseline information on radiation was collected in order to assess and monitor any environmental impacts resulting from the possible release of radioactive materials by the proposed uranium mining project. This information consisted of measurements of background radiation levels and concentrations of natural radioactive materials.

Background radiation from all sources was measured by means of film and thermoluminescent dosimetry techniques. This was done by field measurements at 15 monitoring points on or near the project site plus five dosimeter packets placed in offices in Casper, Wyoming for control purposes. All dosimeters were analyzed after 38 days to determine amounts of radiation exposure. The control groups received the same exposure as dosimeters placed in the field. All the dosimeters showed a total exposure of 13 milliroentgen (mR) of radiation or an annual background radiation exposure of 125 mR.

Background levels of airborne contaminants were measured at several locations on or near the project site. These locations are

3.9-3

shown in Figure 3.5-5. At locations HV1 and HV2, 12-hour particulate samples were collected on preweighed glass fiber filters using a high-volume sampler. Six samples were collected from four locations within the site boundaries to measure alpha-active radioactive daughter products of radon-222 to indicate concentrations of the radon parent. The results of the radiological measurements are summarized in Tables 3.5-3 and 3.5-4.

Samples of soil and vegetation were collected at four locations on the Morton Ranch property. Analyses were performed on these samples and the results presented in Table 3.9-2.

Many of the samples of overburden obtained in the geological studies were analyzed for gross alpha activity and gross beta activity. The results of the analyses are recorded in Table 3.9-3.

Samples of surface water and groundwater were collected from many points on or near the underground and surface mining sites during October and December 1974. All available surface springs or impoundments in the area were sampled. The sampling locations are shown in Figure 3.4-7 and the sample sources are described in Tables 3.4-1 and 3.4-2. A summary of the radiological measurements in the water samples is given in Table 3.9-4. The data summary indicates that measured concentrations of radium-226, thorium-230 and natural uranium generally did not exceed the maximum permissible concentrations for discharge into an unrestricted area (10 CFR 20).

An operating uranium mine and mill are located immediately adjacent to the Morton Ranch property. That mine performs the same types of mining operations as are planned for the proposed project, thus a discussion of radiological emissions is related. At the operating mill and mine, an air monitoring program is carried out quarterly. The ranges of radiological measurements made during the first three quarters of 1974 are shown below.

	<u>Minimum</u> <u>($\mu\text{Ci}/\text{ml}$)</u>	<u>Maximum</u> <u>($\mu\text{Ci}/\text{ml}$)</u>
Uranium	0.36×10^{-13}	2×10^{-13}
Radium-226	0	6.9×10^{-14}
Thorium-230	0	5.6×10^{-14}

The baseline information indicates that the Morton Ranch property has radiation levels that are typical of this region of Wyoming, but somewhat higher than those for the United States as a whole. This higher background level of radiation is attributed to the facts that; (1) the area is at an elevation of about 5000 to 5500 feet above sea level and hence receives more than the average amount of radiation from cosmic rays; and (2) the rocks and soil of this general area contain a somewhat higher than average concentration of uranium and its radioactive daughters. These factors help to explain the higher than average background radiation and the presence of traces of radioactive materials in the local water, air, and biota. Levels of background radiation are believed to have changed little over many years.

Table 3.9-1
BACKGROUND NOISE LEVELS AT THE PROPOSED MORTON RANCH
PROJECT SITE, OCTOBER 14, 1974

	Noise Level Range
Site: Same as RN1, RN2, and RN5	28-33 dB(A)
Time: 1020 MDT*	36-45 dB(B)
Wind Speed: 2 mph**	45-54 dB(C)
Site: Same as RN3	27-34 dB(A)
Time: 1125 MDT	36-42 dB(B)
Wind Speed: 8 mph	45-50 dB(C)
Site: Same as RN4	28-38 dB(A)
Time: 1315 MDT	40-43 dB(B)
Wind Speed: 12 mph	48-66 dB(C)
Site: Same as RN1, RN2, and RN5	28-38 dB(A)
Time: 1440 MDT	40-57 dB(B)
Wind Speed: 12 mph	50-68 dB(C)
Site: Same as RN6	28-38 dB(A)
Time: 1545 MDT	37-48 dB(B)
Wind Speed: 12 mph	60-74 dB(C)

*Mountain Daylight Time

**Wind speeds obtained from onsite mechanical weather station records.

Table 3.9-2

RADIOLOGICAL ANALYSES OF SOIL AND VEGETATION SAMPLES FROM MORTON RANCH

Site	Total Uranium ($\mu\text{g/gm}$)	Gross Alpha (dpm/gm) ^a	Gross Beta (dpm/gm)	Gross Gamma (dpm/gm)	Radium -226 (dpm/gm)	Thorium -230 (pCi/gm) ^b
Site No. 1						
Soil #1	2.1	43.2 $\pm$ 7.3	8.3 $\pm$ 0.5	31 $\pm$ 9	0.9 $\pm$ 0.1	
Soil #2	2.2	26.0 $\pm$ 7.8	3.1 $\pm$ 0.3	26 $\pm$ 3	1.2 $\pm$ 0.1	
Vegetation						
<i>Artemisia tridentata</i>	0.4	9.3 $\pm$ 5.6	21.5 $\pm$ 0.9	0 $\pm$ 20	0.4 $\pm$ 0.1	
Mixed grasses	0.4	4.8 $\pm$ 2.8	15.1 $\pm$ 0.8	8 $\pm$ 3	0.9 $\pm$ 0.5	
<i>Opuntia polyacantha</i>	0.8	0 $\pm$ 5	26.5 $\pm$ 1.8	66 $\pm$ 16	0.0 $\pm$ 0.05	
Site No. 2						
Soil #1	2.5	33.6 $\pm$ 8.5	5.3 $\pm$ 0.4	26 $\pm$ 3	0.9 $\pm$ 0.1	
Soil #2	2.4	41.2 $\pm$ 9.2	7.7 $\pm$ 0.5	27 $\pm$ 3	0.7 $\pm$ 0.1	
Vegetation						
<i>Artemisia tridentata</i>	1.3	0 $\pm$ 5	25.9 $\pm$ 0.9	0 $\pm$ 20	0.0 $\pm$ 0.05	
Mixed grasses	2.5	6.8 $\pm$ 4.5	14.9 $\pm$ 0.9	0 $\pm$ 20	1.6 $\pm$ 0.9	
<i>Opuntia polyacantha</i>	0.1	0 $\pm$ 5	36.6 $\pm$ 1.7	6 $\pm$ 2	0.0 $\pm$ 0.05	
Stream Side						
Mixed grasses	5.5	21.9 $\pm$ 14.1	16.6 $\pm$ 1.1	0 $\pm$ 20	0.0 $\pm$ 0.05	
Site No. 3						
Soil #1						0.68 $\pm$ 0.07
Soil #2	1.3	41.9 $\pm$ 7.2	6.8 $\pm$ 0.4	26 $\pm$ 3	0.8 $\pm$ 0.1	
Vegetation						
<i>Artemisia tridentata</i>	1.4	0 $\pm$ 5	33.7 $\pm$ 1.2	0 $\pm$ 20	0.4 $\pm$ 0.1	
Mixed grasses	0.6	0 $\pm$ 5	14.4 $\pm$ 0.7	16 $\pm$ 5	1.2 $\pm$ 0.4	
<i>Agropyron cristatum</i>						0.0 $\pm$ 0.05
<i>Opuntia polyacantha</i>	1.9	10.5 $\pm$ 7.3	26.8 $\pm$ 2.0	34 $\pm$ 19	0.0 $\pm$ 0.05	
Site No. 4						
Soil #1	4.6	25.6 $\pm$ 4.2	6.9 $\pm$ 0.5	33 $\pm$ 3	1.0 $\pm$ 0.1	0.55 $\pm$ 0.05
Vegetation						
<i>Agropyron cristatum</i>						0.0 $\pm$ 0.05
<i>Artemisia tridentata</i>	0.6	0 $\pm$ 5	26.8 $\pm$ 1.5	42 $\pm$ 15	0.0 $\pm$ 0.05	
<i>Opuntia polyacantha</i>	1.3	22.3 $\pm$ 9.6	31.2 $\pm$ 2.3	0 $\pm$ 20	0.0 $\pm$ 0.05	
Mixed grasses	0.5	0 $\pm$ 5	14.4 $\pm$ 1.0	0 $\pm$ 20	0.0 $\pm$ 0.05	

^adpm = disintegrations per minute^bpCi = picocuries

Table 3.9-3

RADIOACTIVITY ANALYSES OF OVERBURDEN SAMPLES

Sample No.	Drill Hole	Interval (ft)		Gross Alpha ± Precision * (pCi/gm)**	Gross Beta ± Precision * (pCi/gm)**
		From	To		
1	5913	0	2.0	22±8	5±12
2		2.0	12.0	15±7	0±13
3		12.0	22.9	44±11	33±13
4		22.9	79.1	43±11	3±13
5		79.1	107.6	24±8	0±13
6		107.6	158.0	25±8	0±13
7		158.0	184.5	36±10	8±13
8	6400	0	3.0	16±7	0±13
9		3.0	10.0	35±10	4±13
10		10.0	15.0	90±15	32±13
11	6401	0	3.0	21±8	0±13
12		4.0	10.0	36±10	5±13
13		10.0	22.0	23±8	5±13
14		22.0	45.0	37±10	2±13
15		45.0	77.0	25±9	0±13
16		77.0	118.0	26±9	3±13
17		118.0	131.0	76±14	37±14
18	6402	131.0	154.0	19±7	27±12
19		154.0	175.0	31±9	5±13
20		0	3.0	29±10	6±14
21		3.0	9.0	24±8	15±13
22		9.0	27.0	15±7	9±13
23		27.0	49.0	40±11	14±14
24		49.0	99.0	33±10	17±13
25	6403	99.0	124.0	32±10	34±14
26		124.0	160.0	38±10	17±14
27		160.0	205.0	34±10	26±14
28		0	3.0	27±9	7±13
29		3.0	10.0	23±8	6±13
30		11.0	38.0	12±6	11±13
31		38.0	58.0	44±11	10±13
32		58.0	79.0	26±8	17±13

*Variability of the radioactive disintegration process (counting error) at the 95 percent confidence level, 1.96σ .

**Picocuries per gram

Table 3.9-4

SUMMARY OF RADIUM-226, THORIUM-230, AND URANIUM ANALYSES:
MORTON RANCH PROPERTY, OCTOBER - DECEMBER 1974

Location ^a	Sample Number	Source ^b	Uranium (ppb)	Radium-226 ^d ± precision (pCi/l)	Thorium-230 ^e ± precision (pCi/l)
Proposed Underground Mining Site	TVA-1	Surface water	---	0.1±0.5	---
	TVA-2	Surface water	---	0.0±0.5	---
	TVA-3	Surface water	---	0.3±0.6	---
	2685A	Groundwater	7.0	0.7±0.7	0.4±0.5
	2685B	Groundwater	<1.5	0.7±0.7	0.3±0.5
	2685	Groundwater	30	18±3	1.4±0.7
	2686A	Groundwater	28	1.2±0.9	0.7±0.6
Proposed Open Pit Mining Sites	2686B	Groundwater	<1.5	0.4±0.7	0.4±0.5
	2686	Groundwater	94	5.4±2.0	0.4±0.5
	TVA-1A] ^c	Surface water	69	0.5±0.6	0.2±0.4
	TVA-4]	Surface water	---	0.1±0.5	---
	TVA-5] ^c	Surface water	---	0.0±0.4	---
	TVA-2A]	Surface water	48	0.2±0.4	0.4±0.5
	TVA-6	Surface water	---	0.2±0.5	---
	TVA-7	Surface water	68	---	0.1±0.5
	TVA-8	Surface water	---	0.5±0.6	---
	TVA-9A	Groundwater	38	0.2±0.5	---
	TVA-9B	Groundwater	26	0.3±0.6	---
	TVA-10	Surface water	94	1.0±1.1	---
	TVA-11] ^c	Groundwater	200	1.2±0.5	0.1±0.4
	TVA 11]	Groundwater	---	---	0.2±0.5
	TVA-12	Surface water	105	0.8±0.6	---
	TVA-13	Surface water	337	---	---
	TVA-14] ^c	Groundwater	66	2.3±1.8	---
	MX-6401]	Groundwater	22,700	1.2±0.9	0.4±0.5
	TVA-15	Groundwater	670	0.5±0.5	---
	TVA-16] ^c	Groundwater	---	21±7	---
	MX-6403]	Groundwater	117	15±3	0.9±0.6
	TVA-18	Surface water	101	0.5±0.7	---
	TVA-19	Surface water	26	0.8±0.7	---
	TVA-20	Groundwater	20	0.2±0.5	---
	MX-6402	Groundwater	50,200	7.2±2.0	0.9±0.6
	TH-2	Groundwater	90	0.5±0.6	0.0±0.3
	TH-4	Groundwater	62	1.0±0.8	0.7±0.6
	TH-5	Groundwater	493	1.4±0.9	1.5±0.5

a. See Figure 3.4-7

b. See Tables 3.4-1 and 3.4-2

c. Duplicate Samples

d. Maximum permissible concentration for ²²⁶Ra (pCi/l) is: Restricted...400, Unrestricted 30

e. Maximum permissible concentration for ²³⁰Th (pCi/l) is: Restricted...50,000 Unrestricted 2,000

3.9 REFERENCES

1. Environmental Protection Agency. 1974. Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety. Report No. 550/9-74-004.

4.0 ENVIRONMENTAL IMPACTS

The following sections discuss anticipated environmental impacts associated with the proposed uranium mining and land reclamation of Morton Ranch.

4.1 LAND FEATURES AND USES

Implementation of the proposed project will not change the present major land use on the total Morton Ranch property. According to current mine plans, a total of approximately 1800 acres will be disturbed by mining operations over the first eleven years of the project. Additional disturbance, if any, will depend upon the discovery of additional mineable uranium. The disturbance, however, will be incremental, with 12 to 15 percent of the total disturbed acreage withdrawn from livestock grazing at any time since the mining and reclamation activities will be conducted concurrently.

Surface support facilities, new roads, sanitation facilities, and dewatering wells will preempt the use of 87 acres of land during the life of the project. The acreage that will be used for these facilities is shown in Table 4.1-1.

The amount of land used for mining and related activities will vary from year to year depending on the progress of reclamation (see Table 5.1-2). The final open pit or pits will be allowed to fill with water to form a small lake, if acceptable under Federal and state water quality standards. If the water quality is not acceptable and cannot be made so, those areas will also be reclaimed for livestock grazing, by backfilling the pit or pits above the water table, shaping, terracing, and reseeding.

The proposed project could have several beneficial effects on land use: revegetation of disturbed areas with palatable plant species could increase the amount of forage available to livestock.

over that which is currently available; if water in the remaining open pit (or pits) is potable, it could benefit livestock and natural fauna; additional benefits could also be realized from the knowledge gained through research associated with land reclamation.

As discussed in Section 3.1, the property contains no existing or proposed recreation facilities or unique scenic and natural features of recreational value, and receives only incidental recreation use. Thus, the proposed project should have little or no adverse impact on recreation in the mining area and its immediate surroundings.

The major long-term impact on land use may occur regionally because of direct and secondary employment with resulting population increases. To the extent that the increased population utilizes existing housing, services, and infrastructural elements, the land use should not be affected. However, construction of new housing and the associated infrastructure would expand existing urbanized patterns or create new urbanized areas.

There are presently no long-range land use plans adopted by Converse County. Even so, assuming that mining and reclamation produce the postulated future conditions, the proposed project should not prevent use of the land at its current highest use level and thus should have a negligible effect upon land use.

TABLE 4.1-1

PREDICTED ACREAGE PREEMPTED BY MINING FOR THE LIFE OF
THE PROJECT

Use	Acres
Surface Support Facilities	20
New Roads	55
Leach Fields	8
Dewatering Wells	4
Total	<u>87</u>

4.2 GEOLOGIC IMPACTS

Potential geologic impacts on the Morton Ranch property include slope instability, subsidence, and erosion. Impacts associated with the disturbance of the ground- and surface-water regimes are discussed in Section 4.3.

1. Slope Instability - None of the reconstructed land surface will have slopes steeper than 3:1; thus slope stability problems should be minor or nonexistent.

2. Subsidence - Some settlement should be expected in the replaced overburden material. The characteristics of the overburden on the Morton Ranch property suggest that settlement will be about 1 or 2 percent, assuming no extra load is imposed. Thus, a 100-ft.-deep fill might settle as much as 2 ft. after completion of back-filling. The amount of settlement and the degree of irregularity will depend primarily on the method of placement of the fill. In order to ensure maximum permeability and plant-root penetration for revegetation purposes, compaction of the replaced overburden will be kept to a minimum. There will be some settlement under these conditions, but it will probably occur in a short period of time during and after placement.

The proposed underground mining plan includes roof support of mined areas prior to removal of support pillars. This will help minimize the risk of ground surface differential subsidence.

3. Erosion - As discussed in Section 4.3, losses from water erosion of overburden stockpiles during the period of spoil pile construction, and prior to revegetation, will range from about 14 to 98 tons per acre per year. Natural soil losses on the property due to water erosion are estimated to be 0.3 to 1.3 tons per acre per year.

During all the mining operations, especially during exposure of unvegetated overburden piles, wind erosion will occur. Numerous shallow depressions (blowouts) are evident under natural conditions in the vicinity of the Morton Ranch property. The amount of wind erosion which will occur in areas disturbed by mining will be strongly dependent on the texture of the soil exposed on the surface of the stockpiles and on the success of revegetation. Based on the reclamation precautions which will be taken (Section 5.1), this impact is expected to be temporary in nature and will end when reclamation has been completed.

4.3 HYDROLOGICAL & WATER QUALITY IMPACTS

1. Hydrologic Impacts - The impacts on surface waters and groundwaters are discussed below.

Surface Water - As discussed in Section 2.0, ditches will be used to channel surface water runoff away from mining operations into existing drainages. Current mining plans preclude any interruption of the alluvial aquifers (Section 3.4). However, diversion of surface runoff may locally alter the flow of recharge to particular areas of the alluvial aquifers.

Prior to re-establishment of vegetation on overburden piles, runoff will be more than double that from vegetated areas. The effects of this runoff will rapidly diminish downstream as the drainage area increases in size. Runoff for the total drainage area will be increased by approximately 4 to 10 percent as a result of mining activities.

Long-range effects of mining on peak surface water flow are expected to be negligible. When reshaped and vegetated, the areas disturbed by mining will not have significantly different peak flow rates than these areas currently have. Future hydrologic conditions and runoff rates will be affected more by the grazing management plan than by the altered land surface.

Groundwater - Mining operations will affect the sandstone aquifers of the Wasatch and Fort Union formations above and within the ore body. Water levels in deeper aquifers below the Fort Union Formation could be affected by mining operations if the aquifers are penetrated or if artesian pressures cause groundwater in these aquifers

to move upward into pits or mine openings. Based on the present mining plan and on hydrologic studies conducted in the proposed mining areas, it is unlikely that these lower aquifers will be affected by mining.

Some water will drain into the open pits during mining operations. Most of this water is expected to come from the discontinuous exposed sand units containing the ore deposits. Amounts of water that may drain into the mine pits from these aquifers have been estimated from transmissivity values¹ determined from tests conducted in the northern portion of the property. Transmissivity values were found to range from 300 to 1500 gal./day/ft. Using a hydraulic gradient in the project area of approximately 30 ft./mi. and a transmissivity value of about 1000 gal./day/ft., the flow through a 1000-ft. cross-section of the ore body in the southern portion of the property has been estimated to be approximately 5700 gal./day, or about 4 gal./min. Based on experience and well yields in the area, a maximum inflow rate is projected to be approximately 25 gal./min. per 1000 ft. of boxcut.

Continuous discharge of groundwater into the open pit mines is expected to drain the minor amounts of water contained in the discontinuous and irregular sand units above the ore sand and will depress the water level in the ore sand itself to the bottom of the pit. As this cone-shaped depression moves outward from the mine areas, it may lower water levels in wells and may cause the flows from springs in areas adjacent to the mines to decrease or cease. The magnitude of this effect will depend on the hydrologic characteristics

of the individual aquifers penetrated, the duration of mining operations, and the proximity of the mining operations to wells and springs. The hydrologic radius of influence, reflecting depressed water levels, may range from 2 to 4 miles in distance from each open pit, decreasing in magnitude with distance.

The saturated condition of the sand units containing the uranium ore in the northern portion of the property will require dewatering of the lower ore-zone before underground mining and continued pumping to hold the water level down. Initial mining plans call for five dewatering wells, 8 inches in diameter, with an initial combined yield that may approach about 500 gal./min. A significant decline in pumping requirements with time is expected due to decreasing water levels away from the site and minimal vertical recharge.

Full-scale dewatering of the lower aquifer system in the underground mining area will be accomplished by using the wells in conjunction with gravity flow from drifts and underground drill holes. Dewatering of the mine will result in lowering the piezometric surface within the sandstone unit. Because of the long life of the mine and the dewatering program, some effects of this water-level depression may extend radially from 4 to 6 miles, decreasing in magnitude with distance. Springs and wells tapping the lower aquifer within this radius of influence could experience lower water levels, depending on their distance from the mine. Should this occur, appropriate action would be taken.

The upper aquifer is separated from the lower aquifer by an impermeable layer of clayey sediments. Dewatering of the ore zone will have only a minor impact on the upper aquifer consisting of downward seepage or leakage and some local dewatering during construction of the shafts. No dewatering program is planned for the upper aquifer.

The local lowering of groundwater levels as a result of both surface and underground mining is unavoidable, but it is temporary and can be naturally reversed after mining ends. The extent of groundwater lowering will be monitored by means of observation wells, which will also provide sites for water-quality sampling.

Dewatering of the mines will divert groundwater that would otherwise be available for recharge of aquifers down the hydraulic gradient. However, the interruption of recharge to that portion of the aquifer during mining operations is not expected to have an irreversible effect, and recharge capability is expected to be gradually reestablished at the end of mining. Additionally, the total area to be affected by mining is very small relative to the total recharge area available to the affected aquifers.

2. Water Quality Impacts - Activities associated with the proposed underground and open pit mining program that may potentially contribute to water quality impacts include pre-mining activities, dewatering, overburden and ore leaching, sanitary wastewater disposal, erosion, and in-situ mining. These potential impacts are discussed below.

Pre-Mining Activities - Pre-mining activities that may contribute to potential water quality impacts are confined to the drilling and testing of monitoring wells. The testing of these wells may involve the discharge of groundwater to surface drainages. Drainages near the proposed mining sites do not support perennial streams. There are some springs flowing into the north and south forks of Box Creek, but the flows usually do not exceed 2 or 3 gal./min. (about 0.01 ft.³/sec.) and go only short distances from the springs before

soaking into the streambeds or evaporating from standing pools.

Any test water discharged to these creeks would probably be more mineralized than the existing flow. However, this is not expected to result in a significant impact on surface water quality because of the comparatively small volumes expected to be discharged, the short-term nature of the discharges, and the normally restricted flow of surface water.

Mine Dewatering - Water from the underground mine dewatering wells will be pumped to surface holding ponds and used in the mining operation, with any excess being discharged into Box Creek or Cowell Draw. Water from the open pit mines will be pumped to a holding pond and eventually discharged into Box Creek. It is expected that about 1.3 million gal./day will be pumped from the underground mine dewatering wells and about 0.2 million gal./day* will be pumped from the open pit mines, for a total of about 1.5 million gal./day.

Evaporation from the holding ponds can be expected to be about 250,000 gal./day, assuming 50 acres of lagoons, 30 days' storage at 3.5 ft. deep, and 60 in. of evaporation per year. Approximately 50,000 gal./day will be utilized onsite, making a total of about 300,000 gal./day used or evaporated. Thus about 1.2 million gal./day will be discharged into Box Creek. The water in the creek may be used for stock watering downstream and for irrigation.

A flow of 1.2 million gal./day is only about 1.9 ft.³/sec. Assuming an infiltration rate greater than 1 in./hr. in the channel

*Assuming 36,000 gal./day per 1000 ft. of boxcut and pit area of about 64 acres.

and a stream depth-to-width ratio of 1 to 4, flow is generally expected to be sustained in the stream channel for a distance of less than 10 miles. The water would recharge the alluvial aquifer along the stream channel. Therefore, this discharged water could be used directly from the channel or from adjacent shallow wells.

The water discharged from dewatering operations may temporarily affect surface water quality since analyses of site groundwater has shown greater mineral concentrations than the surface waters. However, the water will meet applicable water quality standards prior to discharge.

Overburden Leachate - The geochemistry investigation conducted on overburden from the proposed site revealed the presence of trace amounts of heavy metals. The solubility of these compounds under standard conditions (cold water, neutral pH, and common ions of Cl , HCO_3 , NO_3 , and SO_4) is quite low. However, the slight pH changes that can occur during rain can significantly change solubility. Most metals are more soluble in the reduced valence state associated with low pH levels. Rainwater usually has a pH of slightly less than neutral and is therefore capable of removing more metals from the overburden matrix than the groundwater, which is typically close to or slightly higher than neutral pH. As the rainwater permeates the overburden, it dissolves some of the minerals and raises the pH of the water by the addition of buffering compounds.

An estimate of the approximate maximum potential leachate concentrations of heavy metals that may occur is presented in Table 4.3-1. These concentrations are dependent on the valance state of the metals, the common cations present, the pH and temperature of the water, and the time the water is in contact with the exposed overburden material. These calculated concentrations assume that the infiltration rate of the overburden is equal to or greater than the rainfall intensities so the actual concentrations are expected to be less than these maximum values for the following reasons:

1. The initial rains will remove most of the readily soluble material, leaving less material available for subsequent rains.
2. A hardpan condition is likely to occur after the first few rains on a newly disturbed area, reducing the infiltration rates.
3. The low rainfall quantities expected at the site (10 to 12 in./yr.) should reduce the time the rainwater is in contact with the overburden.
4. Most of the rain expected at the site is of short duration and high intensity and would cause runoff from the overburden piles and large dilution volumes for the leachate.
5. Leachate would be collected and directed to holding ponds where it would be significantly diluted by other water. Any discharged water will meet applicable water quality regulations, possibly necessitating some treatment.

Only minor post-mining overburden leaching is expected since the overburden will have been used in the reclamation program. Thus, no significant impacts on future water quality are anticipated.

Ore Pad Leachate - The ore pad basin and its runoff collection basin will be constructed of rolled-compacted clay which will be impervious to water penetration. Runoff is expected from the ore pad only during periods of intense rainfall. Natural dessication of the ore pad leachate will occur and the solids would be removed from the runoff collection basin periodically.

Onsite Sanitary Wastewater Disposal - The sanitary wastewater generated during mining operations will be disposed of onsite as discussed in Section 2.0. During mining operations, wastewater will be collected from various surface facilities and pumped into leach fields. Before the sanitary wastewater collection and drainage fields are established, the use of onsite chemical toilet facilities may be required. These will be operated by a contractor who will be required to collect and dispose of the wastes in an acceptable manner.

The sanitary wastewater application rate will be about 0.05 to 0.5 in./day which is much less than the permeability (5 to 100 in./day) and equilibrium infiltration rate (generally about 1 to 4 in./day) for the soils on the Morton Ranch property. The application rates of the waste water are expected to be sufficiently low, considering the soil texture, to permit adequate drainage for sanitary wastewater disposal.

Should an unforeseen problem result from sanitary wastewater discharge, disposal would be modified to eliminate the problem by appropriate means such as an expansion of the drainage field.

Erosion Potential - The erosion potential of the disturbed areas prior to revegetation is expected to be between 14 and 98 tons of soil per acre per year. For a short period of time after revegetation, erosion losses are estimated to be about 14 to 24 tons per acre per year. Runoff from the disturbed areas would be directed to holding ponds, where most of the eroded solids would settle out. The water will meet applicable water quality regulations before being discharged into Box Creek.

There may be some post-mining erosion of reclaimed areas, but no more than could be expected from the land in its current natural state. Thus, no significant impacts on future water quality are expected.

In-Situ Mining - The uranium ore that may be considered for solution mining is in a sand matrix of an aquifer between 600 and 900 ft. below the surface on the northern portion of the property and up to 400 ft. deep on the southern portion of the property. Before solution mining would be attempted, those conditions listed in Section 2.0 will be met.

The potential primary water quality impacts due to in-situ leaching would be associated with the non-recovery of the leachate. It may be assumed that it will either be uneconomical or impractical to recover all the leachate. Preliminary studies indicate that even if large quantities of leachate were not recovered, no significant water quality impacts would occur since the leachate would be neutralized through the buffering effect of the mineral - groundwater system,

before the leachate could travel a significant distance from its point of introduction.

Summary of Water Quality Impacts - Most of the water quality impacts associated with the proposed underground and open pit mining will involve the discharge of groundwater to surface drainages. Table 4.3-2 is a comparison of reported ranges of existing surface water and groundwater parameters with various water quality criteria. Some of the radium-226 groundwater concentrations exceeded drinking water standards, stockwatering criteria, and Wyoming discharge standards. When the dewatering flows are equalized in holding ponds, the resulting average discharged radium-226 concentration is expected to be less than the 3 pCi/l limits. If not, concentrations of radium-226 will be reduced by treatment before discharge. Most of the groundwater samples showed concentrations of iron greater than the 0.3 mg/l recommended drinking water standard, and some samples exceeded the proposed irrigation standard of 5 ppm. However, it is expected that equalization in the holding ponds would reduce the average discharged iron concentrations to less than 5 mg/l prior to discharge. Sulfate concentrations of the groundwater have also been found to be greater than the recommended drinking water limit of 250 mg/l. However, equalization is expected to reduce the concentrations to less than this limit. Again, treatment prior to discharge will be used if necessary.

TABLE 4.3-1

MAXIMUM POTENTIAL CONCENTRATIONS OF HEAVY METALS IN OVERBURDEN LEACHATE*

<1 mg/l	1 to 10 mg/l	10 to 100 mg/l	100 to 1000 mg/l	>1000 mg/l
mercury	molybdenum	copper	fluorine	iron
cadmium	uranium	arsenic	zinc	barium
beryllium	cobalt	vanadium	lead	titanium
	boron	yttrium	rubidium	
		niobium	strontium	
			zirconium	
			chromium	
			manganese	
			nickel	

*Dependent on pH conditions, specific ions present, and contact time.

Table 4.3-2

COMPARISON OF REPORTED RANGES OF SURFACE AND GROUNDWATER
PARAMETERS WITH VARIOUS WATER QUALITY CRITERIA

Parameter	Approx. Range of Reported Surface Water Analyses (springs or ponds)	Approx. Range of Reported Ground- water Analyses (wells)	Rec. Max. Concen. for Drinking Water (USPHS, 1962)	Proposed Irrigation Water Stds. (EPA, 1973)	Stock Water Criteria, Effects Noted at Concen. (FNPCA, 1968)	Wyoming Water Quality Regulations* (1974)
Temp. (°C)	2.5-20	9-13	-	-	-	-
pH	7.0-9.7	7.3-8.5	-	4.5-9	-	6.5-8.5
HCO ₃ ⁻ (mg/L)	25-276	73-158	-	-	-	-
CO ₃ ⁻	16-25	NA	-	-	-	-
Alkalinity (as CaCO ₃)	342-410	137-305	-	-	-	-
Spec. Cond. (umhos/cm)	150-3000	260-1200	-	-	-	-
Cl ⁻ (mg/L)	23-30	11-30	250	-	1500 safe	-
U (ppb)	26-337	<1.5-50,000	-	-	-	-
²²⁶ Ra (pCi/L)	0.0-0.4-0.8-0.7	0.2-0.5-21-7	3	-	3	3
²³⁰ Th (pCi/L)	0.1-0.5-0.4-0.5	0.0-0.3-1.5-0.5	-	-	-	-
Na (mg/L)	10-200	10-200	-	-	2000 can be problem	-
SO ₄	7-150	8-1100	250	-	2000 can be problem	-
Ca	20-100	10-150	-	-	-	-
Mg	5-90	2-100	-	-	2000 safe	-
Si	3-10	1-25	-	-	-	-
K	2-3	3-9	-	-	-	-
Sr	0.2-2	0.1-2	-	-	-	-
Hg	0.002-0.2	<0.0001-0.0007	-	-	-	-
N	<0.001	0.02-0.3	-	-	-	-
Fe	0.02-0.2	0.2-25	0.3	5.0	low	-
Al	0.1	<0.001	-	5.0	-	-
Zn	0.002-0.2	0.02-3	5.0	-	50 safe	-
Mn	0.007-0.8	<0.001	00.05	0.2	low	-
Ba	0.02-0.08	<0.001	1.0	-	-	-
Cd	0.002-0.02	0.002-0.09	-	-	-	-
Se	0.002-0.04	<0.005	00.01	-	-	-
Ni	0.001-0.03	<0.001	-	0.2	-	-
Sn	0.002	<0.001	-	-	-	-
Rb	0.001-0.002	<0.5	-	-	-	-
Cu	0.002-0.004	<0.001	1.0	0.2	-	-
Ge	0.002-0.004	<0.001	-	-	-	-
Br	0.02	<0.001	-	-	-	-
V	0.001	<0.001	-	-	5	-
Ti	0.002-0.02	<0.001	-	-	-	-
P	0.002-0.01	<0.001	-	-	-	-

All other heavy metals were below 0.001 ppm (1 ppb) except fluorine and boron, which were not analyzed.

*Also prohibits toxic materials in concentrations toxic to human, animal, plant, or aquatic life.

4.4 IMPACTS TO VEGETATION AND WILDLIFE

1. Vegetation - Temporary loss of vegetation will be caused by the construction and operation of the proposed underground and surface mines (including topsoil stockpiles, overburden storage, and holding ponds). Construction of necessary mine support facilities such as roads, buildings, power lines, and sewage disposal systems will also contribute to temporary loss of vegetation. It is estimated that about 1100 acres of vegetation will be disturbed between 1975 and 1979, and approximately 88 acres of vegetation removed annually from 1979 until termination of mining activities. It is anticipated that approximately 1800 acres of vegetation will have been disturbed by 1987, however, only 900 acres will be disturbed at any one time. Anticipated rate of vegetation removal during various phases of the proposed mining project is shown in Table 5.1-2. Most of these acres will be revegetated within a few years of disturbance.

Most of the vegetation removed would be perennial grasses, big sagebrush, and a variety of forbs. A few areas of riparian habitat could also be lost, depending on the location of roads and power lines.

The quality of vegetation remaining in adjacent areas might also be changed by the proposed project. For example, water erosion could be increased as a result of runoff from disturbed areas, which may cause some damage to vegetation in areas not directly disturbed by construction. Road construction and mining activities are also expected to create fugitive dust, much of which could settle on vegetation and possibly reduce plant vigor.

Dewatering of the mines could lower water levels in springs adjacent to the mines sufficiently to adversely affect the riparian vegetation around the springs for the duration of the mining activities. (See Section 4.3 for a discussion of hydrologic impacts).

Revegetation rates of individual areas would depend on such factors as soil composition, slope, erosional rate, moisture, and seed mixtures used in the reclamation program (see Section 5.1). Following reclamation, natural succession would begin with several annual weedy species such as Russian thistle and cheatgrass that are known to invade recently disturbed areas. Those plants, through time, are usually replaced first by a succession of perennial grasses and forbs and eventually by a combination of perennial grasses, forbs, and shrubs. Reclamation procedures discussed in Section 5.1 of this report are expected to minimize the length of time required to reestablish suitable wildlife habitat in the proposed project area.

2. Wildlife - Many individuals of the smaller animal species such as the small burrowing mammals, snakes, lizards, amphibians, and arthropods that now live in areas that would be disturbed by the proposed mining activities would most likely be lost when the vegetation was removed.

Highly mobile species, such as the larger mammals (antelopes, coyotes, jackrabbits), and most birds, would most likely be able to leave the disturbed areas. The movement of those animals into adjacent undisturbed habitat may bring increased competition for food, shelter, territory, mates, and other necessities. It is likely that the number

of animals presently living in the areas disturbed by the proposed mining activities could be lost for the duration of the disturbance. Once these areas are reclaimed, reestablishment of an animal population will occur.

The ability of animal species to exist in any area is related to the habitat requirements of each species. Herbivores capable of feeding on weedy species or on plants grown in successful attempts at revegetation would be the first animals to establish themselves on the areas disturbed by mining. Predaceous arthropods are also expected to be early inhabitants of revegetated areas.

Other species of animals heavily dependent on sagebrush and other shrubs for food, cover, and/or nesting could take several years to successfully inhabit and reproduce in the reclaimed areas.

The movement of animal species into disturbed areas occurs gradually over long periods of time and is not accomplished by distinct groups at specific times. Each species has its own range of ecological requirements that must be satisfied before it can successfully live and reproduce in a particular habitat. It is difficult, therefore, to accurately predict the precise succession of species.

The increased number of roads, power lines, and people in the proposed project area could have an additional impact on wildlife populations, including a shift to different animal species and possibly

in animal mortality rates. The increased presence of people in the area could result in the destruction of some nests and dens.

The proposed project is expected to bring a total of 575 people into the region (Section 4.5). It is likely that no more than 100 of these people would be hunters. It is assumed that 100 additional hunters in Converse County could be expected to harvest approximately 100 pronghorn antelope and 80 deer. This increase is considered to be of minimal impact to the estimated winter populations of 12,600 pronghorn antelope and 4200 deer in Converse County.

As discussed in Section 4.3, dewatering of the mines could decrease or stop flows in springs in the vicinity of the mines. However, water from the dewatering activities will increase the water available in holding ponds and in the Box Creek and Cowell Draw drainage areas. Thus, animal species dependent on water will have available more water than is presently at the site.

Radioactivity from those sources discussed in Section 4.6 is not expected to be harmful to vegetation or wildlife in predicted concentrations.

It is expected that no wildlife species listed as rare, threatened, or endangered will be affected during the project.

4.5 SOCIOECONOMIC CONSIDERATIONS

Impacts on any socioeconomic environment stem mainly from fluctuations in total population within a region and the spatial distribution of that population. Incremental changes in population directly attributable to a particular project or economic activity may significantly affect employment, income, housing, and community infrastructural elements depending upon existing capacities, the time period involved, and the degree of prior planning and preparation by the local communities. A discussion of the impact on these areas is given below.

1. Employment - The proposed mining operation will require about 90 personnel when mining operations begin. The number of employees will gradually increase until the full operations level of about 280 is reached (in 1977). The skilled personnel required will be underground miners, heavy equipment operators, and heavy equipment mechanics, supplemented by professional and managerial staff. It is expected that some people from Douglas, Glenrock, and Casper will be hired for hourly positions and an in-house program will be instituted for training local employees to enhance recruitment of people from the immediate area. About 130 positions will be filled by people not currently living within commuting distance of the mine. It is this particular portion of the total employment which will primarily affect the socioeconomic environment.

Any increase in basic employment, such as mineral extraction, will induce additional employment within the secondary sectors of the

regional economy as service industries expand to meet emerging needs and consumer demands. Therefore, an employment multiplier appropriate to the study region will provide an estimation of total employment expansion due to the increase in basic employment. In the report Coal and Uranium Development of the Powder River Basin - An Impact Analysis (1974) the Wyoming Department of Economic Planning and Development (DEPAD) reviewed a number of previous studies and concluded that an employment multiplier of 2.5 for permanent employees would, when applied to the total of new-resident permanent employees, produce a reasonable estimate of total employment expansion. Application of this multiplier to the assumed Morton Ranch uranium project in-migrant employees yields a total employment increment of approximately 325 persons. Of the estimated 195 secondary employment positions created, a certain percentage will be filled by present residents of the area who may be unemployed, or possibly by dependants of some Morton Ranch uranium project employees. It is assumed that about 50 percent of these secondary jobs (approximately 95) will be filled by existing local personnel or dependents of mine workers.

Based upon these explicit assumptions, a total of about 230 employment positions will be filled by people who do not currently live in the study area, and will not be dependents or project employees.

2. Population - In order to estimate the total project-related population increment, a population multiplier must be applied to the assumed nonresident employment. The above-referenced study selected a population multiplier of 2.5 for permanent employees, which is based upon various assumptions concerning birth rates,

migration rates, labor-force participation rates, and local employment rates. Applying this population factor to the assumed in-migrant employees yields an estimated total project-induced population increment of 575 persons.

The spatial distribution of this assumed population has significant implications for socioeconomic impact, particularly in housing, infrastructure, and public finance. Discussions with personnel at a nearby uranium mine indicate that most of the professional and managerial staff live in Casper (Natrona County), as do a small percentage of the production personnel. Most of the production, operations, and supervisory staff are distributed between Douglas and Glenrock. Based upon this information, and considering the probable desires of the new-resident employees concerning housing and infrastructural elements, it is assumed that the distribution of in-migrant population will be as follows:

<u>Area</u>	<u>% of Total Increment</u>	<u>Project-Related Population Increase</u>
Douglas	45%	259
Glenrock	30%	172
Casper	20%	115
Rural Converse County	5%	29

The city of Casper had a 1970 population of 39,484. The postulated population increase of 115 persons would represent a

percentage increase of less than 0.3 percent of that total. This fact, coupled with Casper's relative isolation from the projected future population increases within the Powder River Basin, indicates that socioeconomic impacts on that municipality should be relatively slight. For that reason the remainder of this impact analysis will deal only with the possible socioeconomic impacts that will result from the proposed Morton Ranch mining project on Converse County and the towns of Douglas and Glenrock.

Projected population levels for Converse County were discussed in Section 3.8. Those projections developed by DEPAD under their Alternative Future I assumptions show the county reaching a population level of about 19,000 in 1978 and 21,000 in 1979. Although these projections attempt to account for "firm" mineral development projects within Converse County, the authors of the DEPAD study assumed that all population related to any particular project would become residents of the county in which the project is located. That assumption does not appear valid for this study because of the experience at the nearby uranium mine. Recognizing the areas of incongruency between study assumptions, the DEPAD projections will still be utilized and it will be further assumed that population growth associated with the Morton Ranch mines has been accounted for by the state-derived projections.

3. Income - The annual average income of project personnel is estimated to be about \$20,000 before taxes and deductions. Total annual income would therefore be about \$5.6 million. This sum would increase total personal income within Converse

County by about \$4.5 million. The average per capita income derived from this total will depend upon the number of heads of households and the size of employees' families. Using the population multiplier of 2.5, the annual per capita income associated with direct mine employment would exceed \$7500, which is significantly greater than the \$4644 average per capita income in Converse County for 1972. Family incomes would also be higher than the county's 1970 median and mean incomes of \$8947 and \$9191 respectively.

4. Community Infrastructure - This impact discussion draws heavily from a 1974 DEPAD study, Capital Facilities Study, Powder River Basin. The introduction to that report set forth its purpose: "to develop methods and information that will help community leaders and officials in the Powder River Basin Counties plan for the impact of expected mineral development." The report inventoried the existing and proposed public facilities of Powder River Basin counties and those urban areas which will receive the major mineral extraction impacts, defined standards and costs of public facilities, and determined anticipated demands and costs based upon DEPAD population projections.

This study concluded that the following infrastructural elements in Douglas and in Converse County were adequate in relation to existing population levels: water, sanitary sewer, police, recreation, schools, sheriff's department, county fire department, power and light, and libraries. Those facilities considered marginally adequate were the Douglas Fire Department, health facilities (insufficient number of doctors), and county roads and bridges.

The proposed Morton Ranch mines will be only one component of the overall mineral extraction development program assessed in the capital facilities study; therefore, this discussion addresses only those incremental demands placed upon the community infrastructure by the population assumed to be directly attributable to the proposed project.

Based on standards and 1973 costs set forth in the capital facilities study done for DEPAD and the projected influx of population and its distribution as shown above in subsection 2. Population, the demand for additional facilities in Douglas, Glenrock, and Converse County is shown in Table 4.5-1. Project related incremental costs of public facilities and services are shown in Tables 4.5-2, 4.5-3, and 4.5-4 for Converse County, Douglas, and Glenrock respectively. Since the capital facilities study done for DEPAD did not address Glenrock, the standards and costs applicable to Douglas are being utilized for Glenrock in making these projections.

The total annual incremental expenditures for facilities and services in the three areas as discussed above are estimated to be about \$150,000 over the project life. The annual expenditure for schools due to the project related increase in population is expected to approach \$172,000 annually. Counterbalancing these incremental costs will be incremental revenues arising from new residential and commercial development activity and additional revenues arising out of the mining operation.

5. Transportation - Impacts on the transportation system will occur primarily due to commuter traffic. A rise in commuter traffic will occur on Interstate 25 (I-25) from Casper and on State Highway 59 from Douglas. Secondary roads involved will include the Glenrock-Ross Road, Ross Road, and Highland Loop Road. Average daily traffic counts for 1971 showed an average of 3200 vehicles utilizing I-25 between Casper and Douglas and an average of 400 vehicles using State 59 between Douglas and Bill. The increased use of these roads is not expected to be significantly greater except on some secondary roads during shift changes.

6. Housing - Assuming that those local residents who will be employed by the Morton Ranch mining project are presently in adequate housing, then the availability of acceptable housing for in-migrant employees must be determined. In 1970, the Census showed a total of 289 vacant housing units within Converse County, yielding a vacancy rate of 12.9 percent. A total of 146 units were vacant within the town of Douglas (14.2 percent vacancy), while 143 units in the rural county (including Glenrock) were unoccupied (11.7 percent vacancy). Recent community profiles of Douglas and Glenrock¹ report a 1 percent vacancy rate in Douglas and 10 percent in Glenrock. The U. S. Department of the Interior (1974)² has projected that the following housing demands will be evidenced in Converse County:

CUMULATIVE REQUIREMENTS FOR HOUSING UNITS

	1970	1980	1985	1990
Converse County	2247	4400	5000	5100
Douglas	1029	2000	2300	2300
Rural	1218	2400	2700	2800

These projections show a housing demand which, if it is to be filled, would necessitate almost doubling the Converse County housing

stock between 1970 and 1980. Housing costs for a typical single-family residential unit in the eastern Powder River Coal Basin, based on 1972 data, will vary between \$26,000 and \$39,000 and should be expected to rise due to increasing market demand. Some of the new residents may not be financially able to afford a detached single-family dwelling and will decide on lower-cost housing such as multi-family dwellings (apartments, condominiums, and townhouses) or mobile homes. Mobile homes have been popular at major construction and mining sites in Wyoming.

The impact that the project population will have on housing cannot be accurately determined and will represent only a portion of total housing demand within the next decade. Housing market conditions will depend upon numerous variables, including the amount of new housing constructed, types and price ranges of housing, financial ability and preferences of workers, financial market conditions, regulations concerning mobile home parks and subdivisions, and locations of new housing developments.

The long-term nature (more than 10 years) of the proposed mines indicates that most workers will desire permanent single-family dwellings instead of multi-family housing or mobile homes. The scarcity of single-family housing will tend to shift demand to mobile homes, which are single-family but lower in cost than permanent dwellings.

7. Economic Sectors - The Morton Ranch mining project will produce some impacts on the economy of Converse County. These

impacts will result from both the nature of the project and the induced population growth.

Livestock grazing remains the basic economic sector within Converse County, although its importance has been declining. Changes in land use of leased Morton Ranch properties at any one time during the lifetime of the project will temporarily withdraw about .04 percent of the land used for livestock grazing in the county. The temporary withdrawal of this land from livestock utilization during the project lifetime will do little to reduce agriculture as a dominant force in the county.

The substitution of uranium extraction for livestock grazing will represent a temporary shift to a higher economic land value, as mineral production will increase and mineral-related employment opportunities will materialize. The February 1975 issue of Wyoming Labor Force Trends reveals that increased mining employment between February 1974 and February 1975 accounted for more than 60 percent of the total statewide gain in nonagricultural employment. The 3000 workers added over the year brought the total mining employment to 18,300. The proposed project would not only increase county and statewide uranium extraction totals but would also enhance the most rapidly expanding sector of the Wyoming labor market.

Population increases due to the proposed project would have positive effects on trade and service industries in Converse County. The 1972 Census of Retail Trade indicated that annual per capita expenditures were about \$1900. Considering the relatively high incomes of mine workers, per capita retail trade expenditures may exceed

\$2500 annually for project-related population. Applying the secondary employment growth of 200 to the lower figure and the project related population of 260 to the higher figure produces an estimated increase of about \$1,000,000 in retail sales.

Residents of Converse County spent about \$220 each for personal and business services in 1972. Assuming that project-related population expends \$300 per capita and using the same population figures as above, then about \$122,000 will be spent annually for services.

The precise distribution of these increases in trade and service volume cannot be determined. The City of Casper, in adjoining Natrona County, has a more complete trade and service sector primarily because of the demands of its relatively large population. Casper is 24 miles from Glenrock and 50 miles from Douglas, so shopping there is possible for Converse County residents. Some of the increased volume in trade and services would inevitably spill over into the Casper-Natrona County economy, especially until Douglas and Glenrock can expand their commercial sectors to supply the demand of consumers.

TABLE 4.5-1

ADDITIONAL FACILITIES REQUIRED FOR PROJECT-INDUCED POPULATION

	Water (gal./day)	Sanitary Sewer (gal./day)	Police	Fire	School*	Health Care	Library	Recreation
Douglas	116,550	43,512	1 person	-	K-6, 33 stud., 4125 sq. ft.; 7-9, 17 stud., 2940 sq. ft.; 10-12, 21 stud., 4305 sq. ft.	-	none	none
Glenrock	77,400	28,896	none	-	K-6, 22 stud., 2775 sq. ft.; 7-9, 11 stud., 1890 sq. ft.; 10-12, 14 stud., 2952 sq. ft.	-	none	none
Converse County	13,050	4,872	none	-	K-6, 4 stud., 525 sq. ft.; 7-9, 2 stud., 315 sq. ft.; 10-12, 2 stud., 219 sq. ft.	1 M.D.	none	none

*Actual number of new students will depend on the age distribution of in-migrant families. The existing age distribution of Wyoming families has been assumed for these estimates.

TABLE 4.5-2

PROJECT-RELATED INCREMENTAL COSTS OF PUBLIC FACILITIES
AND SERVICES, CONVERSE COUNTY, WYOMING (1973 dollars)

	1980	1985
General Government	\$ 12,500	\$ 12,200
Police	2,800	2,700
Fire	700	700
Health	7,100	7,100
Roads, Airports	18,700	18,300
Water, Sewer	100	100
Parks, Recreation	500	500
Library	2,400	2,300
Agriculture	1,800	1,700
Bonds & Interest	700	600
Revenue Sharing	5,800	5,000
Total Expenditures	53,100	51,200

TABLE 4.5-3

PROJECT-RELATED INCREMENTAL COSTS OF PUBLIC FACILITIES
AND SERVICES, DOUGLAS, WYOMING (1973 dollars)

	1980	1985
General Government	\$ 3,900	\$ 5,200
Police	6,000	6,000
Fire	1,000	1,100
Health	300	300
Roads, Airports	500	500
Sanitation	7,500	7,400
Water, Sewer	9,100	9,100
Parks, Recreation	1,300	1,300
Bonds & Interest	28,300	25,900
Cemetery	500	500
Power	1,300	1,300
Total Expenditures	59,700	58,600

TABLE 4.5-4

PROJECT-RELATED INCREMENTAL COSTS OF PUBLIC FACILITIES
AND SERVICES, GLENROCK, WYOMING (1973 dollars)

	1980	1985
General Government	\$ 2,600	\$ 3,400
Police	4,000	4,000
Fire	700	700
Health	200	200
Roads, Airports	300	300
Sanitation	5,000	4,900
Water, Sewer	6,000	6,000
Parks, Recreation	900	900
Bonds & Interest	18,800	17,200
Cemetery	300	300
Power	900	900
Total Expenditures	39,700	38,800

4.5 REFERENCES

1. Douglas and Glenrock Chambers of Commerce. 1974.
Community Profile.
2. U. S. Department of the Interior, 1974, Final Environmental Statement, Proposed Development of Coal Resources in the Eastern Powder River Coal Basin of Wyoming.

4.6 OTHER

1. Air Quality - The primary sources of gaseous emissions are expected to be the vehicles used in the surface mining and development drilling operations. A list of the number, type, horsepower, and schedule of operation of the vehicles that could be used for these operations is presented in Tables 2.0-3 and 4.6-1. The estimated consumption of energy by these vehicles is approximately 11,025 gal./day of diesel fuel and 400 gal./day of gasoline. Emissions from these vehicles are regulated by ambient air quality standards. Surface mining vehicle emission rates were calculated using emission factors developed by the Environmental Protection Agency¹ and the indicated schedule of operation. The estimated emissions are given in Table 4.6-2.

Gaseous emissions are also expected from the vehicles used in the underground mining operation. The number, type, power, and schedule of operation of vehicles that could be used for this operation are presented in Table 2.0-2. Airborne emissions from vehicles used in underground mining activities is expected to be small, compared with surface-activity emissions. The material mined and the interior walls of the mines are expected to be wet, so dust from the mines is likely to be limited to particulates from diesel engines used to power mining and transportation equipment. Estimates have been made on emissions from underground mining equipment based on Mine Enforcement and Safety Administration standards. Table 4.6-3 presents the maximum allowable average concentrations of pertinent contaminants in the underground mine air. For calculational purposes mine vent effluents at the surface for the two operating shifts were assumed to reach the upper limits of average concentration.

The total volumetric flow rate through the eight vents is expected to be 50,000 ft.³/min. (6250 ft.³/min. from each vent). Estimated maximum average emission rates for each vent were calculated for underground mining by multiplying the assumed maximum concentrations in Table 4.6-3 by this expected flow rate. The resulting estimates of maximum average emission rates are presented in Table 4.6-4.

The estimated emission rates presented in Tables 4.6-2 and 4.6-4 were used as input to a standard short-term diffusion equation.² Calculations were made for "average" conditions and for estimated "worst-case" conditions, and the resulting concentrations (above background levels) were compared with existing short-term standards (Table 4.6-5).

Concentrations for "average" conditions were calculated using the average wind speed for Casper of 13.1 mph (5.86 m/sec) and the most frequent atmospheric stability class, D (neutral).^{*} This should be a conservative basis for calculations since an analysis of both Casper and onsite data by hour of the day for the period of available collected data (August 1974 through May 1975) indicated that wind speeds during the hours when the mine equipment will not be in operation (estimated to be between 2300 and 0700 MST) were, on an average, 3 to 4.5 mph lighter than the winds during the expected hours of operation. Also, more stable atmospheric conditions can be expected to occur during these nonoperating hours.

^{*}Degrees of atmospheric stabilities and Pasquill stability classes are described in Section 3.5.

For comparisons with 1- and 3-hour standards, "worst-case" conditions were assumed to consist of F stability, persistent wind direction, and a wind speed of 1 m/sec (2.2 mph). For comparison with 24-hour standards, "worst-case" conditions were assumed to consist of a wind speed of 1 m/sec, persistent wind direction, 12 hours of F stability (9 p.m. to 9 a.m.), 6 hours of E stability (6 p.m. to 9 p.m. and 9 a.m. to noon), and 6 hours of D stability (noon to 6 p.m.). Note that these "worst-case" conditions are expected to occur infrequently on the Morton Ranch property. In all cases, several wind directions were utilized to determine the maximum possible concentration at the site boundary resulting from the additive effects of the several sources.

The data indicate that concentrations resulting from either the surface or underground mining equipment when added to the background values assumed for this area should not exceed short-term standards.

Annual average concentrations were also estimated for the non-radiological emissions at the site boundaries using a gaseous effluent dispersion model.² Emission rates from Tables 4.6-2 and 4.6-4 were combined with the joint frequency distribution of wind direction and speed by Pasquill stability class (Tables 3.5-6 thru 3.5-11) in the model, and estimates for the maximum site boundary annual average concentrations of the emissions above background levels were determined:

	<u>Underground Mine</u>	<u>Open Pit Mine</u>	<u>Standard</u>
SO ₂	0.002 ppm	0.0003 ppm	0.03 ppm
NO ₂	0.002 ppm	0.005 ppm	0.05 ppm
Particulates	4.0 µg/m*	0.4 µg/m*	60 µg/m ³ (AGM)
CO	No annual standards		

(*Calculated as the annual arithmetic mean. The annual arithmetic mean is normally larger than the annual geometric mean.)

Thus annual concentrations are expected to remain well below official standards when assumed background values are added to these estimated concentration levels.

The other major source of nonradiological air emissions from this project is expected to be fugitive dust. Fugitive dust can be expected from scraping, loading, transporting, and dumping of overburden and ore, as well as from wind erosion of disturbed areas and overburden material before stabilization by revegetation.

Preoperational information on actual emissions of fugitive dust from the planned mining operations is limited. An emission factor of 1.4 tons per acre per month has been developed by EPA¹ from data collected around construction sites in Las Vegas, Nevada, and Maricopa County, Arizona. (By comparison, wind erosion losses from undisturbed land would be about 0.02 tons per acre per year.) The maximum surface area disturbed by mining activities left unreclaimed at any given time during the life of the mining operations has been estimated to be about 900 acres. This estimate includes unpaved roads, pit areas, and overburden and ore piles. Using the 1.4 tons per acre per month emission factor, 900 acres of disturbed soil and rock would produce

approximately 1300 tons of total particulate emissions per month if no mitigating measures were taken. The U.S. Bureau of Mines has estimated that with mitigation the loss can be reduced by as much as 90 percent³ thus limiting maximum particulate emissions to 130 tons per month.

Most of the fugitive dust will be generated in and around the proposed surface mines, and much of it is expected to settle to the ground within site boundaries. Only a small fraction (on a weight basis) will remain suspended beyond site boundaries, and is not expected to exceed state and Federal standards.

2. Noise - Noise levels from the proposed mining activities are expected to be high in the immediate area of operation. However, because of the distances between population centers and the project site, noise should have only a small impact on the human population. Site activities* which may be expected to create significant noise are: scraping and loading operation, vehicles and other mining equipment, and exhaust vent fans.

The scraping and loading operations are expected to produce the highest level of noise. The noise levels in the vicinity of this equipment can be expected to be about 85 dB(A)** at 50 ft. The vehicles and other mining equipment (Table 2.0-3) will also produce noise. A reasonable estimate of the combined noise level in the surface mining area due to the operation of all this equipment is about 85 dB(A).**

*Based on the drill core data, and the recorded mining techniques utilized in adjacent projects, blasting should not be required in the surface mining operations.

**These estimates are based on experience with similar operations.

Much of the noise generated by a surface mining operation comes from within the pit, so the walls will attenuate the noise thus minimizing offsite noise impacts.

For the underground mining operation, exhaust vent fans will probably produce the most noise. It is estimated that these fans will produce about 85 dB(A)** at 50 feet and will run 24 hours a day, seven days a week.

Based on these estimates of source sound levels, and assuming a 6 dB(A) drop for every doubling of distance from 50 feet, noise level predictions were made for site boundaries nearest the open area and nearest the vent fans, as well as for the nearest residence - the Vollman Ranch (Table 4.6-6). Predicted operational sound levels were computed using the equivalent sound level ($L_{eq}(24)$) for site boundary locations, and the day-night weighted equivalent sound level (L_{dn}) formula (EPA)⁴ for the Vollman Ranch. It was assumed that the exhaust fans would operate continuously but the surface mining would cease during the late nighttime hours.

The data indicate that the resulting day-night weighted sound level (L_{dn}) at the Vollman Ranch is below the 55 dB EPA criterion⁴ for the nearest residence. The highest equivalent sound level ($L_{eq}(24)$) predicted is below the 70 dB EPA criterion⁴ for farmland and general unpopulated land.

**These estimates are based on experience with similar operations.

It is expected that wildlife will be more stressed by physical changes in their habitat than by mining noise. Although it is likely that noise has some effect on certain species of wildlife, the Environmental Protection Agency states that a thorough literature search "revealed an almost complete lack of information concerning the effects of noise on wildlife."⁵ While specific effects of mining noise on the wildlife of the Morton Ranch property cannot be determined, based on past experience with similar mining activities, it is likely that most species will quickly become accustomed to the noise from the mining activities.

3. Solid Waste Requirements - Solid waste is expected to be generated by a number of activities associated with the proposed mining operations. Over the life of the project, the major amount of solid waste will be "municipal-type" (paper, cans, bottles, rags, plastics, packing materials, oil filters, lunch bags and wrappers, and garbage). It is estimated that approximately 4 lb. per worker a day of municipal-type waste will be generated. Since peak employment is estimated at approximately 280 people, a total of approximately 1100 lb. of municipal-type solid waste will be generated during peak employment.

Since the expected average density of this type of solid waste is approximately 200 lb/yd³, there will be a maximum of about 6 yd³ of solid waste per day. Based on a 5-day workweek, a conservative total of about 17,160 yd³ of municipal-type solid waste could accumulate during the first 11 years of mining operations.

Possible methods of solid waste disposal available for use on this project are: (1) burning in an approved incinerator, (2) deposit of solid waste in a container for removal to an offsite state approved landfill, and (3) onsite disposal in an approved landfill. For the relatively small amount of solid waste that is expected, consideration may be given to onsite disposal. Assuming that a compaction density of 1000 lb/yd³ is achieved, a landfill site with a maximum volume of 3120 yd³ (12 ft. deep, 24 ft. wide, 295.5 ft. long) is expected to be required to dispose of the solid waste generated over the first 11 years of the project. The use of a landfill is not expected to have any significant adverse impacts.

4. Radiological - Some emissions of radioactive materials will be realized from both surface and underground mining operations. Since underground mining will be performed beneath the existing water table, the water content of the material mined is expected to be high enough to reduce dust generation to a minimal level, so that radioactive materials associated with particulates will not be emitted from mine ventilation systems in any appreciable quantity. The principal airborne radioactive effluent from the mining activities would be radon-222, which is released as a decay product from the radium contained in uranium ore. The gas would be vented into the atmosphere from the underground mine exhausts and also at lower concentrations from the surface mines.

From past experiences with similar underground mining operations radon-222 concentration can be estimated. Estimates indicate the maximum average concentration in the mine vent exhausts to be

4×10^{-7} $\mu\text{Ci}/\text{ml}$. This value is most likely high but serves as the best available estimate. With an expected volumetric flow rate of $6250 \text{ ft}^3/\text{min}$ ($2.95 \times 10^6 \text{ ml}/\text{sec}$) through each of the eight vents, the resulting estimated maximum average radon-222 emission rate would be $1.2 \mu\text{Ci}/\text{sec}$, or $0.1 \text{ Ci}/\text{day}$, from each vent. The vents will be operated 24 hours a day, 7 days a week.

This emission estimate was combined with the available information on vent height and location with respect to site boundaries (Figure 3.5-3) and the joint frequency distribution of wind direction and speed by Pasquill stability class. These data were used as input to the annual average gaseous effluent dispersion model which provides annual average concentrations (above background) of radon for 14 downwind distances in each of the 16 cardinal wind directions. These data as well as approximate distances to the site boundary from a reference point called the "center" of the mine vent area are presented in Table 4.6-7. The dispersion model takes into account the actual distance and direction of each of the eight mine vents from each of the reference points for which concentrations were calculated. The estimated average concentration at the site boundary in the direction of the prevailing wind (toward the northeast) is less than $3.4 \text{ pCi}/\text{m}^3$. The annual average concentration calculated for the nearest resident (Vollman Ranch) is $2.0 \text{ pCi}/\text{m}^3$. The maximum average radon-222 concentration along the entire site boundary is estimated to be less than $40 \text{ pCi}/\text{m}^3$ which converts to less than $4.0 \times 10^{-11} \mu\text{Ci}/\text{ml}$. This estimate is well below the maximum allowable concentration of radon-222 in air released to unrestricted areas (10 CFR 20).

The emission rate of radon from the surface mining areas would vary according to the amount of ore exposed, ore grade, moisture content, and other factors. Attempts to measure radon concentrations in existing surface uranium mines revealed no significant concentrations above existing ambient concentrations. Therefore, any increase in the airborne concentrations of radon or its daughter products in unrestricted surface mining areas is expected to be undetectable.⁶

Dust generated by surface mining activities and by wind erosion of disturbed soils and overburden material is expected to contain approximately the same concentrations of natural uranium, thorium-230, and radium-226 as the dust collected during background sampling (Table 3.5-3) and should not exceed concentrations found in particulates collected around a nearby uranium mine and mill, which averaged approximately 9.0×10^{-14} $\mu\text{Ci/ml}$, 2.9×10^{-14} $\mu\text{Ci/ml}$ or less, and 2.5×10^{-14} $\mu\text{Ci/ml}$ or less for natural uranium, thorium-230, and radium-226, respectively.

The groundwater and surface water are not expected to contribute any significant amounts of radioactivity to the environment. Dissolved radioactive isotopes in some of the water pumped from the mines during dewatering could produce extremely low levels of exposure. These effluents would be carefully monitored

for radioactivity levels and would be treated, if necessary, to reduce the concentrations of any radioactive materials to acceptable levels. Possible impacts of the release of these waters are discussed in Section 4.3.

Vegetation and wildlife on the Morton Ranch property could be exposed to some radioactivity as a result of mining activities, principally from radon gas emitted from the underground mine ventilation system. Radioactive emissions from the mining operations are expected to be so low that significant effects should not occur.

5. Historial and Archaeological - As discussed in Section 3.7, no sites listed in or nominated for the National Register of Historic Places are located on or in the vicinity of the Morton Ranch property, nor does the property contain sites listed in the state historical inventory which may qualify for future enrollment. If additional investigation identifies any historical resources not presently known or recognized as having significant cultural value, information on such sites or structures will be coordinated with the Historic Division of the Wyoming Recreation Commission.

The only archaeological discovery of any significance on the project site is addressed in section 3.7. Should this site be disturbed or should future alterations in project plans require the use of the site for mining or other activities, the state archaeologist or the personnel from the University of Wyoming Department of Anthropology will be notified, respectively; so appropriate action can be initiated. Precautions to protect additional archaeological finds are discussed in Section 5.2.

Table 4.6-1

VEHICLES WHICH COULD BE USED FOR DEVELOPMENT DRILLING

No. of Units	Descriptions	Power	Brake Horsepower	Hours per Week Each Unit
2.	Drill Rigs	Diesel	208	80
2	Water Trucks	Diesel	208	80
3	Pickups	Gasoline	175	80
1	Backhoe (1/2 cu yd)	Diesel	120	80

Table 4.6-2

POSSIBLE VEHICULAR EMISSIONS FROM SURFACE MINING OPERATIONS*

Pollutant	Emissions		
	First Shift (gm/sec)**	Second Shift (gm/sec)**	Annual (tons/yr)**
Particulates	1.28	1.00	18.8
Sulfur Oxides	2.67	2.07	39.1
Carbon Monoxide	27.26	22.27	409.5
Nitrogen Oxides	36.68	17.49	538.8

*Emissions due to gasoline and diesel fuel consumption.

**Emissions given in grams per second are for times when vehicles are operating, whereas the tons per year figures reflect the schedule of operations for the year.

Table 4.6-3

**MINE ENFORCEMENT AND SAFETY ADMINISTRATION AIR CONTAMINANT
STANDARDS* (8-hour time-weighted averages)**

Sulfur Dioxide	13 mg/m ³
Carbon Monoxide	55 mg/m ³
Nitrogen Dioxide	9 mg/m ³
Nuisance Particulates	10 mg/m ³

*"TLVs - Threshold Limit Values for Chemical Substances in Workroom Air Adopted by ACGIH for 1973," as indicated in 30 CFR, Chapter 1, Part 57.

Table 4.6-4

**ESTIMATED MAXIMUM AVERAGE NONRADIOACTIVE EMISSION RATES
FROM EACH OF EIGHT UNDERGROUND MINE VENTS**

Sulfur Dioxide	0.38 gm/sec ^a	0.63 tons/yr ^b
Carbon Monoxide	0.162 gm/sec	2.68 tons/yr
Nitrogen Dioxide	0.027 gm/sec	0.45 tons/yr
Particulates	0.030 gm/sec	0.50 tons/yr

^aDuring operation of diesel-powered mining equipment underground.

^bAnticipated operation of diesel equipment 16 hours per day, 5 days per week.

Table 4.6-5

**CALCULATED SHORT-TERM CONCENTRATIONS (ABOVE BACKGROUND) OF NONRADIOLOGICAL POLLUTANTS
DUE TO EMISSIONS FROM MINING EQUIPMENT ENGINES**

Pollutant	Concentration at Boundary Nearest Open Pit Mine ^a		Concentration at Boundary Nearest Underground Mine Vents ^b		Short-Term Standard
	"Average" ^c	"Worst-Case" ^c	"Average" ^c	"Worst-Case" ^c	
Sulfur Dioxide (3-hr avg)	0.002 ppm	0.024 ppm	0.007 ppm	0.123 ppm	0.5 ppm
Carbon Monoxide (1-hr avg)	0.052 ppm	0.677 ppm	0.080 ppm	1.44 ppm	35 ppm
Particulates (24-hr avg)	1 $\mu\text{g}/\text{m}^3$	8 $\mu\text{g}/\text{m}^3$	7 $\mu\text{g}/\text{m}^3$	70 $\mu\text{g}/\text{m}^3$	150 $\mu\text{g}/\text{m}^3$
Nitrogen Dioxide (1-hr avg)	0.042 ppm	0.554 ppm	0.008 ppm	0.146 ppm	none

Notes:

^aEmissions from the open pit mine were assumed to emanate from a line source, 1 mile long (indicating the approximate length of the pit area) oriented in a northwest-southeast direction and were assumed to diffuse according to Turner's (1970) equation 5.18. The site boundary with the highest concentration was found to be approximately 1 mile to the southwest.

^bEmissions from the mine vents were assumed to emanate from eight point-sources of 7.5-foot height and to diffuse according to Turner's equation 3.2. Contributions from upwind vents were added together. The nearest site boundary was found to be about 390 feet south of the southeasternmost vent. This was also found to be the worst location with respect to combined concentrations from several vents.

^c"Average" and "worst-case" assumptions are indicated in the text.

Table 4.6-6

SUMMARY OF ESTIMATED SOUND LEVELS DUE TO PROPOSED MINING ACTIVITIES

Receptor Location	Distance from Source	Background	Predicted Operational Sound Level	Predicted Total
Boundary nearest open pit mine area	3940 ft	$L_{eq}(24)=30dB$	$L_{eq}(24)=46dB$	$L_{eq}(24)=46dB$
Boundary nearest vent fans; under- ground mine area	394 ft	$L_{eq}(24)=30dB$	$L_{eq}(24)=68dB$	$L_{eq}(24)=68dB$
Vollman Ranch	5510 ft	$L_{dn} = 37dB$	$L_{dn} = 51dB$	$L_{dn} = 51dB$

Table 4.6-7

**ANNUAL AVERAGE RADON CONCENTRATION ESTIMATES AT VARIOUS DOWNWIND DISTANCES
FROM CENTER OF UNDERGROUND MINE VENT AREA^a**

DIREC- TION	DISTANCE (meters)													
	672.	984.	1176.	2640.	3000.	4000.	5000.	6000.	7000.	8000.	9000.	10000.	20000.	30000.
N	.68E+02	.17E+02	.10E+02	.12E+01	.76E+00	.44E+00	.31E+00	.22E+00	.18E+00	.14E+00	.12E+00	.10E+00	.35E-01	.19E-01
NNE	.22E+02	.30E+02	.48E+02	.24E+01	.18E+01	.10E+01	.68E+00	.48E+00	.38E+00	.31E+00	.27E+00	.21E+00	.72E-01	.40E-01
NE	.16E+02	.14E+02	.12E+02	.44E+01	.34E+01	.18E+01	.12E+01	.92E+00	.72E+00	.56E+00	.48E+00	.40E+00	.14E+00	.72E-01
ENE	.12E+02	.10E+02	.88E+01	.44E+01	.34E+01	.23E+01	.16E+01	.12E+01	.10E+01	.80E+00	.68E+00	.56E+00	.20E+00	.12E+00
E	.12E+02	.92E+01	.92E+01	.37E+01	.30E+01	.21E+01	.16E+01	.12E+01	.10E+01	.80E+00	.68E+00	.56E+00	.21E+00	.12E+00
ESE	.12E+02	.11E+02	.11E+02	.34E+01	.28E+01	.10E+01	.72E+00	.56E+00	.44E+00	.36E+00	.30E+00	.27E+00	.92E-01	.52E-01
SE	.17E+02	.28E+02	.38E+02	.19E+01	.16E+01	.96E+00	.64E+00	.48E+00	.37E+00	.30E+00	.25E+00	.21E+00	.76E-01	.44E-01
SSE	.36E+02	.24E+02	.20E+02	.22E+01	.17E+01	.10E+01	.72E+00	.56E+00	.44E+00	.35E+00	.29E+00	.25E+00	.88E-01	.52E-01
S	.39E+02	.23E+02	.12E+02	.27E+01	.22E+01	.13E+01	.10E+01	.72E+00	.56E+00	.48E+00	.38E+00	.33E+00	.12E+00	.64E-01
SSW	.28E+02	.16E+02	.12E+02	.28E+01	.21E+01	.12E+01	.84E+00	.64E+00	.48E+00	.39E+00	.32E+00	.27E+00	.96E-01	.52E-01
SW	.38E+02	.80E+02	.23E+02	.20E+01 ^b	.16E+01	.92E+00	.64E+00	.48E+00	.36E+00	.29E+00	.24E+00	.20E+00	.68E-01	.39E-01
WSW	.40E+02	.40E+02	.16E+02	.19E+01	.15E+01	.84E+00	.56E+00	.40E+00	.31E+00	.25E+00	.21E+00	.18E+00	.60E-01	.34E-01
W	.20E+02	.76E+01	.64E+01	.16E+01	.13E+01	.92E+00	.64E+00	.48E+00	.38E+00	.30E+00	.25E+00	.21E+00	.72E-01	.40E-01
WNW	.21E+02	.84E+01	.52E+01	.12E+01	.96E+00	.56E+00	.44E+00	.32E+00	.24E+00	.19E+00	.16E+00	.14E+00	.48E-01	.26E-01
NW	.32E+02	.64E+01	.44E+01	.84E+00	.68E+00	.38E+00	.28E+00	.21E+00	.15E+00	.12E+00	.10E+00	.84E+00	.30E-01	.17E-01
NNW	.28E+02	.80E+01	.56E+01	.64E+00	.52E+00	.32E+00	.18E+00	.14E+00	.96E-01	.80E-01	.64E-01	.56E+00	.19E-01	.11E-01

Approximate Site Boundary

^a Total from 8 vents; ground level radon-222 (pCi/m^3) (Based on Casper Star Program, 1967-1971).

^b Vollman Ranch

Notes:

-Holland plume rise equation

$-.16E-01 = .16 \times 10^{-1} = .016$

4.6 REFERENCES

1. U. S. Environmental Protection Agency. 1973. Compilation of Air Pollutant Emission Factors. 2nd edition. EPA Pub. No. AP-42 (April).
2. Turner, B. D. 1970. Workbook of Atmospheric Dispersion Estimates. Washington, D. C.: U. S. Environmental Protection Agency.
3. Dean, K. C.; R. Havens; and K. T. Harper. 1969. Chemical and Vegetative Stabilization of a Nevada Copper Porphyry Mill Tailings. Bureau of Mines RI 7261. Washington, D. C. U. S. Department of the Interior.
4. U. S. Environmental Protection Agency. 1974. Information on Levels of Environmental Noise Requisite to Protect Public Report No. 550-9-7-004.
5. U. S. Environmental Protection Agency. 1972. Report to the President and Congress on Noise. Senate Document No. 92-63.
6. U. S. Atomic Energy Commission. 1972 Environmental Survey of the Nuclear Fuel Cycle. Washington, D. C.: Fuels and Materials Directorate of Licensing.

5.0 MITIGATING MEASURES

The primary mitigating measures to be taken in the mining operations are the surface mine reclamation actions, discussed below in Section 5.1. Additional mitigating measures taken in the engineering, construction, and operation of the mines are discussed in Section 5.2.

5.1 PROPOSED RECLAMATION PLANNING AND PROCEDURES

The implementation of reclamation plans provides the most significant mitigating measure for minimizing the long-term environmental impacts that would be caused by the proposed project. For this reason, major sections of this environmental statement are supportive of the reclamation plans, for instance, the mining plan (Section 2.0) and the baseline data (Sections 3.1 - 3.9).

The reclamation procedures outlined herein are consistent with the requirements of the Wyoming Land Quality Rules and Regulations.

Dr. Morton May of the Agriculture College of the University of Wyoming developed a reclamation plan for the proposed project which included material contained throughout the body of the environmental statement. Dr. May and his associates considered input data from TVA and United Nuclear Corporation and their consultants, as well as input from the Colorado School of Mine Research Institute and the U. S. Soil Conservation Service. Dr. May's reclamation plan is summarized below.

1. Reclamation - Land Use Relationship - The purpose of the reclamation program is to restore all lands disturbed by mining activities to a productive condition consistent with the present and historical uses of the area. Land uses, both past and present, are discussed in detail in Section 3.1 of this report. Although uranium is currently being mined and milled on properties adjoining

the Morton Ranch, the general land use is for the grazing of cattle and sheep. The goal of the reclamation program, therefore will be to reestablish productive conditions for livestock and native fauna grazing.

Surface mining activities will disturb approximately 85 to 90 surface acres annually. Underground activities will disturb less than 2 surface acres each year. As mining continues, these projections can be updated, and will be reported in the required annual reports.

Due to the nature of underground mining operations, the semipermanent nature of the structures involved, and the constant addition of material to the waste piles, reclamation of these limited acreages will not be possible until normal mining operations cease.

2. Topsoil and Overburden Stockpiling - As one of the first steps in mining, topsoil will be removed from all areas affected by mining activities (see Section 2.0), and will be segregated from the other overburden materials and marked in accordance with the applicable regulations. If desirable and feasible, the subsoil will also be properly marked and stockpiled.

Conservation measures will be used to control wind and water erosion of the topsoil piles. If the stockpiled topsoil is

not to be used for an extended period of time, it will be lightly seeded to provide temporary cover. If possible, stockpiles will be located on the leeward slopes of existing hills to protect them from prevailing winds. They will also be placed away from existing drainages so as not to increase water erosion.

As mining proceeds, reclamation and overburden stripping will take place concurrently. Consequently, some of the stripped topsoil may be placed on backfilled material or in other disturbed areas. When this occurs, applicable conservation procedures will be instituted based on seasonal seeding practices.

3. Backfill - With the exception of the last one or two surface mines, the open pits will be backfilled with overburden prior to covering with topsoil and revegetating. The portals of adit level underground mines in the open pit area, if any, and the shafts in the underground mine area will be sealed in accordance with Federal and state regulations. In the event that state and Federal water quality standards can be met and permission is granted from the State Engineer and Land Quality Division of the Wyoming Department of Environmental Quality, a lake will cover 5 to 10 acres of the final pit or pits. If the water quality of the lake does not meet the standards, or if permission is not granted by the State Engineer, the area will be backfilled above the static water level and revegetated.

Roads, building sites, remaining overburden and tailings piles, and refilled pit areas will be graded to blend with the natural contours of the adjacent undisturbed topography. Slopes will not be greater than 3 to 1. Roads and buildings or other structures may be retained by the surface landowners for use after the mining activity has ceased. This would be reported to the Wyoming Land Quality Division and any reclamation needed for these facilities would then become the responsibility of the surface owner.

If final placement and shaping of overburden material result in excessive compaction, the top 18 to 24 inches will be harrowed while the overburden is relatively dry, when better shattering will result.

4. Disposal of Undesirable Materials and Waste - Periodic sampling and testing of the overburden will be conducted to determine the content of heavy metals, radioactive compounds, or any toxic materials. As discussed above, toxic materials in the overburden are not expected to be a problem on the Morton Ranch property. However, if toxic materials are encountered, the Administrator of the Land Quality Division of the Wyoming Department of Environmental Quality will be contacted for disposition procedures. It is anticipated that undesirable materials will be buried at least 6 feet below the surface, at a level free from groundwater movement.

5. Topsoil Preparation - At least six to nine inches of topsoil is expected to be available for placement over the shaped and prepared backfill or overburden piles. Care will be exercised

to avoid movement of topsoil material when too wet, particularly the heavy (fine-textured) soils.

Prior to seeding any area, the needed surface modifications will be made; particularly those needed for water conservation purposes. Pitting may be used for improved water retention, or it may be necessary to harrow the area in order to improve percolation rates. In some areas it may be necessary to cover the surface with straw or other mulch to minimize erosion.

If necessary, undesirable plants will be controlled by accepted control measures in compliance with existing state and federal regulations. Weed control should not be needed once the desired native plant species become established.

6. Seeding Rates, Species, and Methods of Application -

The Morton Ranch property was previously used for year-round grazing by domestic livestock, and it will be reclaimed for this use.

Table 5.1-1 provides a recommended list of native plant seed species (except for crested wheatgrass), mixtures, and seeding rates.

The species listed are adapted to the climatic and soil conditions existing in the area and are also highly palatable to livestock, tolerant to grazing, and available for year-round use by livestock.

The seed mixtures are designed to yield the maximum number of seedlings that the area can support. Modification of the seeding mixture will be considered throughout the period of reclamation if onsite performance of the species indicates that changes are needed.

5.1-6

Seeding will be performed in accordance with rules, regulations, specifications, and standards adopted by the Wyoming State Conservation Commission as approved by the Land Quality Division.

In all cases where surface conditions and slopes permit, seeding will be performed with a drill. If slopes are too steep for seeding equipment, the seed mixture will be broadcast at approximately twice the rate given in Table 5.1-1 to be followed by brush drag or similar treatment to ensure seed coverage.

Seed will be planted about 1 inch below the surface in sandy soil. In areas where the topsoil contains considerable clay, the depth of seeding would be reduced to approximately 1/2 inch.

6. Time of Seeding and Protection of Seeded Areas - Time of seeding is very critical in Wyoming. Previous range seeding trials, under semiarid conditions similar to those found at the Morton Ranch, have shown that available moisture is the limiting factor in seedling establishment. Due to the low annual precipitation, seeds must be planted when maximum moisture is present for germination and seedling establishment. Most of the species recommended should be planted in the early spring (before mid-April) or late fall (after mid-October). Seed from native browse species and fresh seed of Indian ricegrass will be planted in the fall season, if possible, to increase germination the following spring. (See subsection 2. Topsoil, above for additional discussion of varying seeding requirements throughout the typical years.)

To ensure optimum plant establishment, seeded areas will be protected by fencing, herding, or similar approved animal control techniques, for two growing seasons or until the vegetation is capable of renewing itself without further attention.

7. Reclamation Schedule - As shown in Table 5.1-2, the present mining plans indicate reclamation would begin in 1976 on areas disturbed during construction of utility lines (gas, electric, and telephone) and drill sites. In 1979 the open pits would begin to be backfilled and reclaimed as additional open pits were created. By the end of 1979, 315 acres of the 1100 acres disturbed would be reclaimed. This progression of filling the depleted open pits would continue until mining operations are completed.

No plan can be formulated to account for all the situations that must be dealt with during reclamation. Because of variability in climatic conditions and localized differences in soil characteristics, a number of judgmental decisions on seeding technique, soil preparation, and cultivation would have to be made on a site-by-site basis. To assist in making these decisions, the assistance of experts in various state and Federal agencies and institutions who have already assisted in formulating reclamation procedures will be sought.

8. Cooperation - As indicated above, assistance of various Federal, state, and local agencies such as the U.S. Soil Conservation Service and the Converse County Agriculture Agent, will be sought to

help develop and review many of the phases of the ongoing reclamation program. The inputs from these agencies will help assure optimum reclamation results and ensure that the reclamation program is successful.

TABLE 5.1-1

RECOMMENDED SEED SPECIES AND MIXTURES FOR THE MORTON RANCH PROPERTY*

SPECIES	Mixture (pounds of pure live seed/acre)			
	Basic Mixture	Heavy Soil		Sandy Soil
		(Upland)	(Depres- sions)	
Agropyron dasystachyum (Critana)	3	3	2	3
A. desertorum (Nordan or Summit)	3	2	1	3
A. riparian (Sodar)	1	1	1	
A. Smithii (Rosana)	3	4	4	
Oryzopsis hymenoides (Northern ecotype)				2
Atriplex canescens (Northern ecotype)				1
Onobrychis viciaefolia (Eski or Remont)			3	
Others**				

*Species descriptions, characteristics, and growth tolerances available from the U. S. Soil Conservation Service.

**If areas are selected where use by game animals is to be encouraged, some spot hand seeding, using locally collected or proven adapted ecotypes, may be accomplished with rabbitbrush (*Chrysothamnus* spp.), big sagebrush (*Artemisia tridentata*), or winterfat (*Eurotia lanata*). These shrub species will contribute to seasonal forage availability and protective cover for game animals and birds. Autecological data of these shrub species, relating to seeding or planting, can be obtained from Dr. Morton May, Plant Science Division, Agriculture College, University of Wyoming, Laramie, Wyoming.

Table 5.1-2

AN ESTIMATE OF SURFACE ACRES DISTURBED AND RECLAIMED ON THE MORTON RANCH PROPERTY (1975-1987)

Description	1975 Disturbed Reclaimed	1976		1977		1978		1979	
		To Be Disturbed	To Be Reclaimed	To Be Disturbed	To Be Reclaimed	To Be Disturbed	To Be Reclaimed	To Be Disturbed	To Be Reclaimed
Existing Roads (est.)	153								
New Roads		51			4				
Surface Facilities		20							
Sanitation (leach fields)		8							
Power Lines		55	55						
Gas Lines		4	4						
Telephone Lines		6	6						
Drill Sites	13	99	57	24	14	24	14	23	13
Pit Areas				64		64		64	34
Overburden Areas				210		210			116
Solid Waste Areas		2		1	2	1	1	1	1
Dewatering Wells		2			2				
Total	166	247	118	303	18	299	15	88	164
Cumulative	166	413	118	716	136	1015	151	1103	315

Table 5.1-2 (continued)

Description	1980		1981		1982		1983	
	To Be Disturbed	To Be Reclaimed	To Be Disturbed	To Be Reclaimed	To Be Disturbed	To Be Reclaimed	To Be Disturbed	To Be Reclaimed
Drill Sites	4	4						
Pit Areas	64	64	64	64	64	64		158
Overburden Areas		86		86				
Solid Waste Area	1	1	1	1	1	1	1	1
Dewatering Wells								
Total	69	155	65	151	65	65	1	159
Cumulative	1172	470	1237	627	1302	692	1303	851
Description	1984		1985		1986		1987	
	To Be Disturbed	To Be Reclaimed	To Be Disturbed	To Be Reclaimed	To Be Disturbed	To Be Reclaimed	To Be Disturbed	To Be Reclaimed
Drill Sites								
Pit Areas								
Overburden Areas								
Solid Waste Area	1	1	1	1	1	1	1	1
Dewatering Wells								
Total	1	1	1	1	1	1	1	1
Cumulative	1304	852	1305	853	1306	854	1307	855

Source: United Nuclear Corporation.

5.2 OTHER MITIGATING MEASURES

1. Engineering, Construction, and Operation - Measures that would mitigate some of the adverse impacts during construction and operation of the proposed project have been incorporated into the design and operation plans for the Morton Ranch mines. These measures include the following:

1. Culverts will be provided under all roads where drainage channels exist.
2. Berms and ditches will be constructed around active open pits, mine shafts, and at the toes of spoil piles, and will channel surface water into holding ponds. If necessary, the water will be treated before release into the Box Creek drainage system. This should minimize potential localized erosion and water quality problems.
3. All water pumped from the mines will be directed to holding ponds for removal of solids prior to use and/or discharge into the Box Creek drainage system. Other mine drainage treatment will be performed if found necessary by ongoing water quality monitoring.
4. Sanitary sewers and leach fields will be constructed at the surface and underground mining sites to properly treat sanitary wastes generated by the mine personnel.
5. Water trucks will be used to control dust by sprinkling heavily traveled roads on the property.
6. Wind erosion of disturbed soil will be reduced by restricting travel across loose material and by beginning revegetation on all overburden piles as soon as possible.
7. Worker protection from noise will be provided in compliance with the Occupational Health and Safety Act as applicable.
8. Power and telephone lines and gas lines will be placed so as to minimize visual impact. Burial will be performed as necessary.
9. The mining operations will comply with applicable Federal, State, and county laws, regulations, and standards for air and water quality.

10. Disturbance of the property will be minimized by using or improving existing roads where feasible, preventing off-road vehicular traffic when roads are available, and minimizing power-line rights-of-way.
11. Ventilation will be provided in the underground mine in compliance with the health and safety regulations of the U. S. Bureau of Mines.

2. Solid Waste Disposal - Cleared vegetation will be disposed of by either grinding as mulch for revegetated areas or burial beneath replaced overburden.

"Municipal-type" solid waste will be disposed of by approved incineration; in an approved landfill onsite, maintained in compliance with applicable regulations; or in a local approved landfill operated by a municipality, county, or private contractor. Materials, such as ferrous metals, which have an economic value may be collected for further use or recycling.

3. In-Situ Mining Precautions - Before in-situ solution mining, the precautions noted in Section 2.0 will be taken. Additional in-situ mining precautions are discussed below.

Vertical migration of leach solution and leachate through exploration drill holes (those not used for production purposes) will be prevented by pressure-grouting the required holes above the ore zone. Vertical migration through confining layers would be minimized by operating the well field so that the differential pressure between the ore zone and overlying or underlying formations is kept fairly small, depending on the permeability of confining layers. This will

be done by carefully controlling injection and production rates, or by injection into layers adjacent to the ore zone for pressure maintenance.

To help mitigate potential adverse impacts caused by horizontal migration of leach solution and leachate, pumping without injection of leach solution will be continued after economic recovery of ore has ceased until the aquifer has been sufficiently flushed of leach solution. This would help prevent the down-gradient migration of undesirable ions. Down-gradient monitoring wells, in addition to the wells used for the in-situ recovery operation, could be utilized for this pumping operation.

4. Precautions to Protect Archaeological Finds - The only archaeological site of any significance discovered during the archaeological survey is located at least two miles away from any project activities. Most of the proposed project site is on private property not open to the public. Therefore neither the general public nor mine personnel would normally frequent the area of the archaeological site.

In the event that the site is disturbed, the State archaeologists will be notified so that they may take appropriate action. In the event that future alterations in project plans require the use of the site for mining or other activities, personnel from the University of Wyoming Department of Anthropology will be contacted for reevaluation of the site, and possibly excavation if necessary.

All equipment operators and others who have occasion to be on the mining site will be made aware that potentially valuable archaeological sites could be found. Archaeological specimens, such as projectile points, grinding stones, charcoal, ash, burned animal bones, shells, matting, basketry, fire-cracked rock, human bones from burials, and unusual changes in the soil of the mine walls will be noted. If any archaeological site is discovered, the State archaeologist will be notified immediately, and the site protected pending investigation.

5. Monitoring Programs - Monitoring programs planned for reclamation and air quality, groundwater, water quality, and radiological data collection are given below.

Reclamation - Onsite monitoring programs will be employed to obtain data for annual reports to the Wyoming Land Quality Division of the Department of Environmental Quality and to utilize developing technology in the reclamation program. Only those procedures and methods which are considered to be acceptable, repeatable techniques will be utilized. In general, the studies will supply the following information:

1. Vegetation productivity each year as compared to productivity on similar undisturbed range sites
2. Stability and self-sustaining ability of seeded mixtures as expressed by ground cover, composition of stand, and productivity

3. Uses of reclaimed and similar undisturbed sites made by native fauna
4. Soil stability
5. Soil fertility level and requirements
6. Presence or absence of toxic materials
7. Comparison of climatic fluctuation effects on reclaimed and undisturbed sites.

Data accumulated by the monitoring programs may be utilized in determining the following:

1. Adaptability and performance of newly available plant species or ecotypes
2. Browse establishment to promote wildlife habitat
3. Comparative effects of special treatment (fertilization formulations and rates, pitting, and mulching)
4. Evaluation of topsoil depths and topsoil-subsoil mixtures
5. Evaluation of changes in topsoil characteristics related to time of stockpiling
6. Treatment(s) for stabilizing stockpiles of topsoil
7. Comparison of microclimatic parameters of reclaimed and undisturbed sites.

Groundwater Monitoring - Piezometers have been installed at both the proposed surface and underground mining areas. At the surface mining area they were drilled in pairs, one in the mining area and one adjacent to it. Piezometers were installed at the underground site in such a manner as to permit selective sampling from the three primary aquifer systems in the area. Monitoring will be provided throughout mining operations in order to detect changes in levels and quality of the groundwater.

As mining operations progress, the need for additional groundwater monitoring may become apparent. The location, depth, and number of additional stations needed would be determined by analysis of data accumulated from the existing monitoring stations.

Water Quality Monitoring - The water quality monitoring program was initiated in the summer of 1975 for both surface water and groundwater. Future analysis will be performed for specific conductance, temperature, pH, bicarbonate, total dissolved solids, common elements and compounds, radium-226, thorium-230, and gross alpha and beta radioactivity. Groundwater monitoring will be conducted quarterly, whereas surface water monitoring will be conducted only during those quarters when surface water flows normally occur. Depending on levels of uranium, radium-226, and thorium-230, more frequent sampling may be required.

All point source discharges from the mining operations will be monitored in accordance with the terms of the NPDES permit.

Radiological Monitoring - Health and safety regulations as specified in Title 30, Part 57 of the Code of Federal Regulations and as enforced by the Mining Enforcement and Safety Administration (MESA), require that the radioactive content of the air in the underground mine be kept low by dilution and replacement of the mine air with fresh air from the surface. Monitoring will be provided on a routine basis in the underground mine spaces to ensure compliance with these regulations.

Although virtually no radiological effects on soil or vegetation are expected from this project, monitoring of these substances will be carried out at approximately four locations on a quarterly basis. Samples will be analyzed for uranium, radium-226, and thorium-230. Depending on the levels of uranium, radium-226, and thorium-230, adjustments to this monitoring will be made as appropriate.

The monitoring of water for radiological parameters will be performed in conjunction with the water quality monitoring discussed above. This program includes routine radiological measurements to observe any changes in concentrations of uranium, radium-226, or thorium-230 that may be attributed to mining activities. If any significant increases above baseline levels are observed, additional monitoring will be performed.

6.0 ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

In determining the environmental effects associated with this project, the following adverse effects which cannot be avoided have been identified.

There will be a temporary change in land use from livestock grazing to mineral extraction during the life of the project. Approximately 900 acres may be affected at any one time. Reclamation of the mined areas will commence shortly after the mine is developed and will continue until all of the mined area is reclaimed to its current highest use level with the possible exception of one or more 5 to 10 acre lakes that may be left at the end of the project life. These lakes would serve the purpose of providing water in an area where surface supplies are scarce.

There will be permanent alteration of specific topographic features at the surface mining areas due to remaining spoil piles and the possible lake to be left at the end of project life. However, the land surface will be graded to blend with the natural topography and revegetated.

Land erosion from water and wind will occur during the life of the project as overburden is removed and stockpiled. The effects of this will be reduced by locating the spoil piles in areas that will reduce exposure to wind and by revegetation.

There will be an increase in stream flow in Box Creek and possibly Cowell Draw during the life of the project due to dewatering

operations. The quality of this water will be monitored before release to Box Creek or Cowell Draw and treated if necessary to meet water quality standards.

The dewatering operations will also cause a depression of groundwater levels in the vicinity of the mines; however, this should be self-correcting after the cessation of mining.

There will be a temporary alteration of plant and animal species diversity on the site due to the disruption of natural habitat.

There will be a temporary minor degradation of air quality in the immediate vicinity of the mining operations due to fugitive dust and exhaust emissions from combustion-driven mining and support equipment and vehicles. This is not expected to exceed ambient air quality standards and will cease after project completion.

The increase in population due to the project will place additional pressure on the surrounding communities and to the county to provide needed community services. If the costs to provide these services are not compensated by additional revenues, the resultant effect would be adverse.

While the construction and operation of the Morton Ranch uranium mines will result in some adverse environmental effects which cannot be avoided, these effects should not conflict with the environmental goals set out in Section 101 (b) of NEPA. This project is also consistent with the Nation's stated policies on energy utilization.

7.0 ALTERNATIVES TO THE PROPOSED ACTION

This section discusses the alternatives to mining the Morton Ranch property that were considered by TVA. The alternatives considered are:

1. No Action.
2. Purchase of Uranium.
3. Mining Other Properties.

1. No Action - Since there are known uranium deposits on the Morton Ranch property, mining is expected to occur regardless of TVA's participation. Therefore, the alternative of TVA taking no action in the mining of the Morton Ranch property would only have the effect of placing TVA in the position of having to acquire the uranium that can be supplied from this source by other means. As discussed below under the other alternatives, this option would decrease the dependability of the uranium supply available to TVA.

2. Purchase of Uranium - TVA initially anticipated being able to meet all of its projected requirements for nuclear fuel by purchasing it on a long-range delivery basis from the nuclear steam system supply vendors and on the open market through invitations for bids to uranium suppliers. More recently, TVA has engaged in direct negotiations with uranium suppliers. By these means, TVA has been able to obtain contractual commitments for approximately one-half of its uranium fuel needs through the 1980's. TVA plans to continue its efforts to purchase uranium on the open market; however, to date, this approach alone has not assured TVA a dependable long-range supply of uranium. The proposed participation in

the Morton Ranch uranium mining activity will help provide TVA with a dependable uranium supply.

3. Mining Other Properties - Although TVA is considering participating in mining ventures at other locations in the future, the lead time that is necessary to develop a mine to production level precludes the development of other properties in the same time frame in which TVA can obtain uranium from the Morton Ranch property. The uranium from this property is needed to help provide TVA with a dependable supply of nuclear fuel.

As indicated, a decision by TVA to participate in mining at another location instead of Morton Ranch would not preclude the development of this property by someone else. Moreover, similar types of impacts associated with the Morton Ranch development would probably be encountered at other locations.

4. Conclusions - TVA has concluded that, because of the present status of the uranium supply market and indications of its future development, it should participate in the development of the Morton Ranch property now in addition to the purchasing of uranium on the open market in order to help assure a dependable supply of uranium for its future needs.

8.0 SHORT-TERM USES VERSUS LONG-TERM PRODUCTIVITY

In assessing the construction and operation of the mines for cumulative and long-term effects, TVA has made the following determinations.

The local short-term uses of the environment are those required to construct and operate the mine. These include the preparation of the site and construction of buildings and facilities, the removal of overburden and the extraction of uranium ore, the release of gaseous effluents into the ambient air, and the disposition of the excess water from the dewatering operations into nearby streambeds. However, the effects of these uses will be minimized and should have no long-term effects on the environment.

Most of the short-term uses of the site will result in no significant effect on the long-term productivity of the land affected since the land will be reclaimed to its current "highest use" level.

The operation of the Morton Ranch uranium mines will not result in any significant long-term environmental degradation. All effluents discharged to the air, water, and land will be within levels which are considered acceptable for the short-term uses of the environment. Environmental monitoring will include the sampling and analysis of soil and water. This will provide data for detecting and evaluating specific parameters of environmental impacts which might lead to long-term effects, in order that timely corrective action can be taken if required.

In view of the foregoing environmental considerations, the immediate benefits to be derived from the initiation of this project are not expected to significantly curtail the long-range beneficial uses of the natural resources of the area except for the mined uranium.

Thus, in the sense that each generation is trustee of the environment for succeeding generations, the Morton Ranch uranium mines can be constructed and operated in a manner to protect the environment so that succeeding generations will be enabled to attain full use of the environment except for the uranium that will be removed. In addition, the proposed action is consistent with the Nation's stated energy utilization policies.

9.0 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The resources utilized in this project that can be considered as irreversible and irretrievable commitments are: (1) the uranium ore that is mined, (2) the energy expended in the mining operation and support facilities such as petroleum products and electricity, and (3) the materials and equipment used in the mining and support facilities that are unrecyclable such as concrete and some metals.

The commitment of natural resources associated with this project's construction and operation are small when compared to the benefit obtained from the uranium which will be mined.

10.0 CONCLUSION

This environmental statement reflects the manner in which TVA has used a systematic, interdisciplinary approach in incorporating environmental considerations into the decision-making process for the Morton Ranch uranium mines.

The mining will interact with the environment in these principle areas: (1) release of minute quantities of radioactivity to the air and water, (2) temporary change in land use, (3) increased land erosion due to water and wind during the life of the project, (4) increased runoff and depression of groundwater levels due to dewatering operations, (5) temporary alteration of plant and animal species diversity in the immediate area of the surface mines, and (6) permanent alteration of specific topographic features at the surface mine areas. Reclamation of the mined areas will begin shortly after the start of mining and will continue until shortly after the end of mining. The mined areas will be reclaimed to its present land use level.

The mines can be constructed and operated without significant risk to the health and safety of the public. The uranium acquired by TVA from the mines will help assure that TVA obtains and maintains a dependable supply of uranium for use in its nuclear-fueled electric generating plants.

After weighing the environmental costs and the technical, economic, environmental, and other benefits of utilizing an energy resource

consistent with national energy policies, TVA has concluded that the overall benefits of the project far outweigh the monetary and environmental costs, and that the action called for is the mining of the Morton Ranch uranium deposits.

