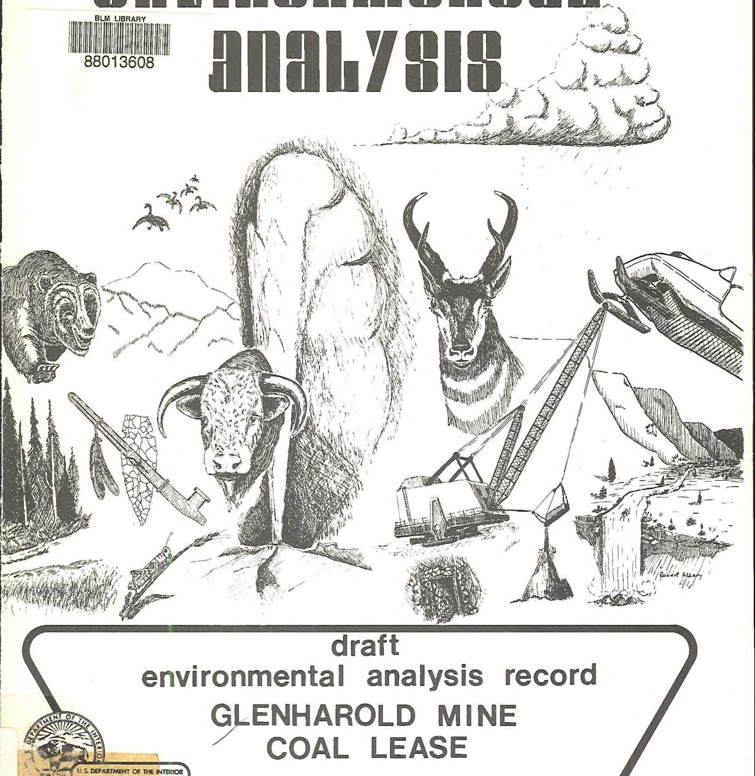
environmental analysis



draft
environmental analysis record
GLENHAROLD MINE COAL LEASE
miles city district montana

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ERRATA SHEET

Glenharold Mine

Page 2-45	Last sentence should be omitted.
Page A2-76	Reads..."(Appendix 2, Page)".... Should read..."(Appendix 2, Page A2-71)"....
Page A2-86	Overlay printed without base map.

INTEREST AND COMMENT SOLICITATION NOTE

The Bureau of Land Management has received an application for the lease of approximately 480 acres of federal coal in Mercer County, North Dakota. The Bureau has prepared a draft impact analysis dealing with the proposed lease. This draft will be available for comment during the month of August, 1976. The final analysis will be initiated at the end of that period.

Any comments you may have with regard to the analysis would be greatly appreciated. Your comments should be directed to, District Manager, Miles City District, Bureau of Land Management, P. O. Box 940, Miles City, Montana 59301, Attention: Environmental Coordinator. It is requested that your comments be sent so that they may be received no later than September 3, 1976.

ACTIVITY 1212

1791 - ENVIRONMENTAL ANALYSIS

DRAFT

GLENHAROLD COAL LEASE AMENDMENT M-21209(ND)

ENVIRONMENTAL ANALYSIS RECORD

June 1976

Prepared By:

Bob Bennett	Environmental Coordinator
Ed McTaggart	Recreation Planner
Dave Lindberg	Surface Protection Specialist
Dave Roberts	Biologist/Ecologist
Tom Durst	Geologist
Jerry Clark	Archaeologist
Jerry Pittman	Surface Protection Specialist
Craig Garland	Soil Scientist
Dick Jewell	Hydrologist

Miles City District
United States Department of the Interior - Bureau of Land Management

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INTRODUCTION

Consolidation Coal Company is proposing to ammend an existing coal lease application of approximately 2,000 acres in order to mine, in the near future, 480 acres of federal coal. The lease amendment is located within Consolidation Coal Company's Glenharold Mine near Stanton, North Dakota. This analysis examines and records the possible impacts the may result if the Bureau of Land Management (BLM) leases the coal. Physical and biological impact analyses are for the most part limited to the lease amendment area, but air, water, and socio-economic factors are analyzed on a broader scale.

The original lease of 2,000 acres is a portion of a proposed action which is to be the subject of a regional environmental impact statement. In the meantime, a specific analysis on the 480 acres within the mine area is necessary because the current mining operations have placed the tracts in the path of the on-going mining activity. Consequently an immediate decision by the BLM and Department of the Interior is mandatory. Otherwise the coal will be bypassed, the area will still be impacted by surrounding coal mining, and the coal may be committed to non-use because it may not be economically feasible to mine the bypassed coal in the foreseeable future.

SUMMARY

Consolidation Coal Company's Glenharold mine has been in operation since 1965, supplying fuel to Basin Electric's Leland Olds power plant at Stanton, North Dakota. Currently, Consolidation Coal Company has applied for approximately 2,000 acres of Federal coal to augment its existing reserves. Action on this lease is pending the results of a Regional Environmental Impact Statement.

Consolidation Coal Company proposes to amend the existing lease application so that 480 acres can be offered for competitive sale immediately in order to sustain their existing mining operation.

This Environmental Analysis Record (EAR) indicates that mining on much of the 480 acres would provide only limited additional environmental impacts beyond those already occurring due to the present mining activities. The exceptions to this are those areas which have steep side slopes and are occupied by hardwood thickets. These areas may prove difficult or impossible to reclaim. The proposed action would facilitate a more efficient and practical mining and reclamation plan and would prevent loss of coal within a mined area. This is called a loss of coal because present and foreseeable future mining economics may not permit a later return to mine the bypassed coal.

CHAPTER 1

DESCRIPTION OF PROPOSED ACTION

APPLICANT'S PROPOSAL

The proposed action to be analyzed in this Environmental Analysis Record is the amendment of a pending Federal coal lease application from Consolidation Coal Company to lease, under the Secretary of Interior's Short Term Criteria, 480 acres of Federal coal. The coal is located in Mercer County, North Dakota, near the community of Stanton (see Figure 1-1). The area is composed of five tracts with the following legal descriptions:

W½SE¼, Sec. 20, T. 144 N., R. 84 W.	80 acres
N½N½, Sec. 32, T. 144 N., R. 84 W.	160 acres
E½E½, Sec. 30, T. 144 N., R. 84 W.	160 acres
NW¼NE¼, Sec. 30, T. 144 N., R. 84 W.	40 acres
SW¼SE¼, Sec. 30, T. 144 N., R. 84 W.	40 acres
	480 acres

Large scale demands for coal in North Dakota is a recent occurrence. In the past, most of the coal was used for local consumption. In the Fall of 1965 Truax-Traer Coal Division of Consolidation Coal Company began supplying fuel from the Glenharold Mine to Basin Electric Power Cooperative's Leland Olds No. 1 generating plant at Stanton. The plants construction, and recent expansion the result of increasing energy


Stanton, North Dakota
Consolidation Coal Company
Glenharold
Mine
T.144N., R.84W.
20
29
32
30
Federal Coal Lease
Amendment
N

FIGURE 1-1

consumption, the substitution of coal for other forms of energy because of its low cost, abundant supply, and the fact that coal from this area burns relatively free of pollutants.

The initial supply rate of coal to the Stanton generating plant was approximately 1.3 million tons a year. To meet expanded generating capability, the supply rate was accelerated to 3.8 million tons annually.

Consolidation Coal Company, a wholly owned subsidiary of Continental Oil Company, is incorporated under the laws of the State of Delaware, headquartered in Pittsburgh, Penn., and authorized to hold coal leases issued under the Federal Mineral Leasing Act of February 25, 1920, as amended.

The Federal government does not own any of the surface rights in the proposed lease. The mineral rights are administered by the Bureau of Land Management (BLM). Currently, in order to lease Federal coal, the lease application must meet the Secretary of the Interior's Short-Term Criteria for coal leasing. The BLM determined in October 1975, from information furnished by Consolidation Coal Company, that the criteria have been met. This determination was based on the following facts:

1. The coal to be produced is committed to Basin Electric's Leland Olds generating plant.
2. The Glenharold Mine began producing in 1965 reaching a production rate of 1.3 million tons per year by 1973. The proposed operating plan indicates a step-up of production to 3.8 million

tons for the next 25 years. Except for minor local use, all coal is produced for Basin Electric's power generating plant.

3. Consolidation has invested 5 million dollars and has a planned commitment of an additional ten million dollars for equipment and surface facilities at the project.

4. Consolidation's interest in Federal coal leases in the State of North Dakota is minor - of 600.77 acres, 560 are involved in the Glenharold operation. This coal is a part of the total project and should be utilized. These existing leases are insufficient, in themselves, to provide sufficient coal for the same market as the ongoing mining operation.

5. Nonlease could cause permanent loss of the Federal coal resource if bypassed during mining of contiguous lands. Mining of scattered Federal mineral holdings would generally not be economic as a self-sustaining operation.

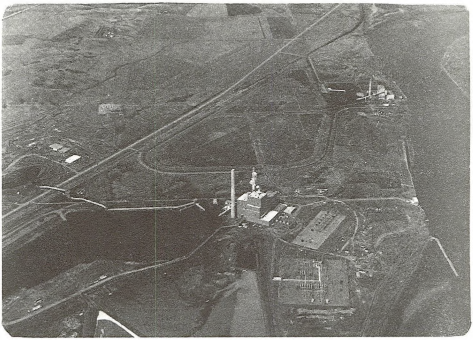
Based on the preceding, it was judged that the lease application met the Secretary's criteria two, that is, the coal is needed as a reserve for production in the near future, and that the BLM could therefore proceed with processing the lease.

The ultimate purpose of the lease is to provide part of the electrical energy needs of a large portion of the Mid-West. All of Glenharold's production, except that used by local ranchers and farmers as stoker fuel, goes to Basin Electrical Cooperative's Leland Olds power plant. The power plant is composed of two generating plants, a 215 Megawatt (MW) older plant, and a recently constructed 440 MW plant. The total plant capacity is 655 MW. This power is distributed to over one million rural consumers throughout North Dakota, South Dakota, Minnesota, Montana, Wyoming, Nebraska, Iowa and parts of Colorado and Kansas. The Leland Olds plant is one of twelve generating plants operated by Basin Electric Cooperative providing power to 101 District Cooperatives within this service area. In addition, through agreements with the Bureau of Reclamation and the Mid-Continent Area Power Pool (MAPP), this power can be distributed to other areas of the United States during periods of high use (see Photo pages 1-6 and 7).

The Glenharold Mine (see location map) is located on the west bank of the Missouri River approximately 20 miles south of the Garrison Dam and Lake Sakakawea, and about 35 miles north of New Salem. New Salem is a small town located on I-94, 20 miles west of Mandan. The closest community to the mine is Stanton, approximately three miles north of the mine.

The planned life of the mine is twenty-five years. The total area of the mine will be approximately 7,000 acres. At the current rate of production 270 acres per year will be disturbed. Consolidation Coal Company currently has limited Federal coal under lease. In 1973, the company applied for 1,922.44 acres of Federal coal to meet its commitments. The application was not acted on because of the Secretary of the Interior's moratorium on new coal leases. The current 480 acre lease application is part of the original application.

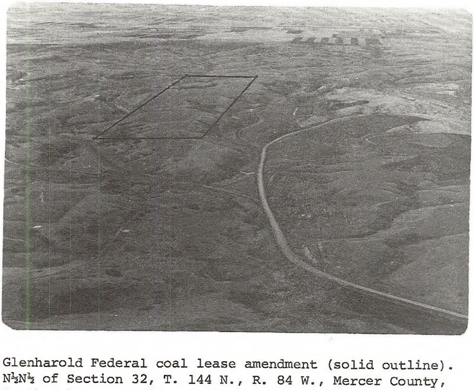
Current technology and economics dictate that the area be developed by strip mining techniques. The operation at Glenharold is now at the



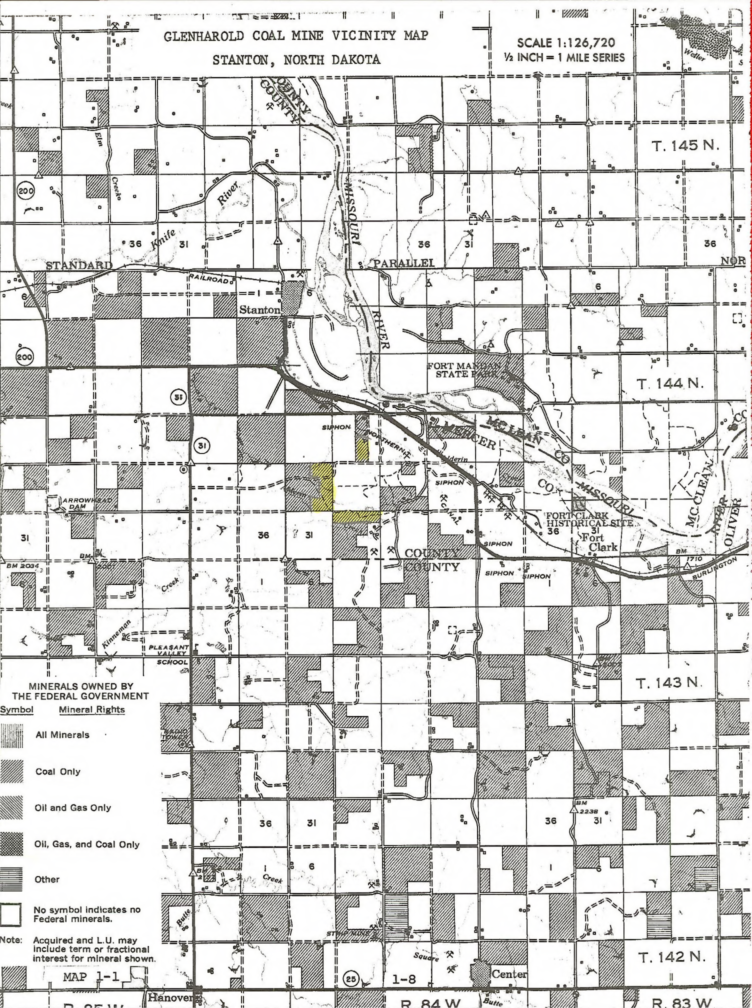
Glenharold Coal Mine office (left center), Basin Electric Power Plant (center), and UPA Power Plant (upper right) near Stanton, North Dakota. T. 144 N., R. 84 W. April - 1976. Aerial view looking west.

Glenharold Federal coal lease amendment (solid outline). W½SE¼ of Section 20, T. 144 N., R. 84 W., Mercer County, North Dakota. April - 1976. Aerial view looking southwest.

Glenharold Federal coal lease amendment (solid outline). $E\frac{1}{2}E\frac{1}{2}$, $NW\frac{1}{4}NE\frac{1}{4}$, and $SW\frac{1}{4}SE\frac{1}{4}$ of Section 30, T. 144 N., R. 84 W., Mercer County, North Dakota. April - 1976. Aerial view looking northeast.



Glenharold Federal coal lease amendment (solid outline). $N\frac{1}{2}N\frac{1}{2}$ of Section 32, T. 144 N., R. 84 W., Mercer County, North Dakota. April - 1976. Aerial view looking west.


GLENHAROLD COAL MINE VICINITY MAP
STANTON, NORTH DAKOTA
SCALE 1:126,720
½ INCH = 1 MILE SERIES
T. 145 N.
T. 144 N.
T. 143 N.
T. 142 N.
R. 84 W.
R. 83 W.
STANDARD
Stanton
PARALLEL
MISSOURI RIVER
Knife River
FORT MANDAN STATE PARK
FORT CLARK HISTORICAL SITE
Fort Clark
MERCER COUNTY
MC LEAN CO.
OLIVER COUNTY
ARROWHEAD DAM
PLEASANT VALLEY SCHOOL
STRIP MINE
Center
Hanover
MINERALS OWNED BY THE FEDERAL GOVERNMENT
Symbol
Mineral Rights
All Minerals
Coal Only
Oil and Gas Only
Oil, Gas, and Coal Only
Other
No symbol indicates no Federal minerals.
Note: Acquired and L.U. may include term or fractional interest for mineral shown.

MAP 1-1

1-8

point where, within the immediate future, the Federal coal in the proposed lease must be either leased or bypassed. If leased the coal would be mined immediately, if bypassed the likelihood of it ever being mined is remote. The cost of returning to isolated tracts of coal within a mined area is currently prohibitive.

If the mining begins immediately, there is enough coal on the proposed lease area to operate the mine for about two years. The tracts are intermingled with privately owned coal however, and as a consequence, mining on the tracts would take considerably longer to complete. Reclamation should be completed within three years after termination of the mining permit term according to North Dakota State Law. The company could be given three one-year extensions automatically and two one-year extensions if they are requested, and reclamation requirements have not been satisfied. This means that if leased immediately the time frame for the action would begin this year, and could be completed, including reclamation by 1981. It would be more realistic to assume some delays in reclamation would require extensions. As a result the action probably would not be finished until the mid 1980's (see Figure 1-2).

The mining takes place in two stages of implementation. Each will be discussed in detail. Because the mine is presently in existence the construction of roads, and facilities will not be analyzed. The two stages that will be analyzed are Mining and Reclamation. These stages contain several discrete operations which, even though described separately, may occur simultaneously.

Stanton, North Dakota
Consolidation Coal Company
N
Glenharold Mine
Tentative
Mine Development
1975
1976
1977
1978
'75
'76

Mining

Removal and Stockpile of Soils

Following classification and mapping by a State registered soils classifier, the soils are removed in two steps. Step one is removal of topsoil by heavy equipment. The topsoil is either stockpiled in a specified area for later use during reclamation or spread on reshaped spoil piles and subsoil for reclamation. The second step is removal of subsoil. The subsoil is stockpiled separately from the topsoil in order to reduce mixing of topsoil and subsoil when respread during reclamation, or placed directly on reshaped spoil piles.

Wind and water erosion of the stockpiles may be controlled by proper positioning and seeding. The seeding composition must be approved by the BLM District Manager and the North Dakota Public Service Commission.

Removal of Remaining Overburden

The remaining overburden (all materials between subsoil and coal seam) is removed with an electric powered, 55 yard or 34 yard dragline. The Company currently has two machines operating simultaneously in separate pits. The 55 yard dragline is capable of removing overburden to a depth of 110 feet, while the 34 yard dragline is capable of removing overburden to a depth of 70 feet. The overburden is piled adjacent to the cut. Each succeeding cut's overburden is placed in the immediately preceding trench. This operation will continue 24 hours a day. A grader or front end loader will follow the dragline and remove loose clay from the top of the coal seam.

Blasting, Excavation and Loading

Following removal of the overburden, the exposed coal seam is progressively drilled and blasted using ANFO (ammonium nitrate-fuel oil mixture) to fracture the coal. A 14 yard or 16 yard, electric, coal-loading shovel (depending on the pit) excavates the coal and loads it into 180 ton, diesel powered, coal haulers.

Transportation, Delivery and Crushing

The coal is transported from the pit, up a 7% grade ramp road, to unpaved haul roads joining the mine and to coal preparation facilities. At the preparation facilities, it is dumped, crushed to less than three-quarter inch, and loaded on a conveyor belt for movement to the power plant, or stockpiled for future loading.

Reclamation

Regrading

During reclamation, the overburden piles are reshaped to a level or gently rolling form. This includes the final highwall, or last cut, which normally has little overburden put back into it. The highwall is cut back and graded to blend with the adjacent terrain. Large bulldozers and scrapers are normally used in this process. Reshaping is usually done two to three spoil piles behind the mining operation, depending on weather and working conditions.

Topsoiling

Following the reshaping process, subsoil is spread on the graded overburden. Topsoil is then replaced and spread over the subsoil. The topsoiling operation is normally performed by large wheeled tractor-scrapers during dry seasons of the year.

Revegetation

The seeding operation involves site preparation (such as contour plowing) and seeding with appropriate vegetation. This may include the use of a bulldozer, but is normally limited to farm tractors and implements.

If the project proceeds as proposed, all existing Federal and State laws and regulations pertaining to coal strip mining and its associated affects on the environment would apply.

There are also a number of standard stipulations, or minimum mitigating measures, included in federal leases. The following standard stipulations are general and relevant to this analysis (additional and more specific mitigating measures will be developed as a result of the findings in this report):

1. Toxic overburden which could jeopardize reclamation shall be buried at a minimum depth of five feet below the surface.
2. Soil material to be used in reclamation shall be removed, segregated, stockpiled, or placed directly on areas that have been mined and prepared for reclamation. Soil material which will be stockpiled

for more than one year shall be seeded. Protective measures, such as orientation of stockpiles and reduced stockpile slopes, shall be taken to prevent soil loss to wind and water erosion.

3. Full use must be made of available technology to prevent or minimize subsurface piping and slumping by support material.

4. All spoils must be graded to the approximate original land topography.

5. Prior to beginning reclamation, the Company, the surface owner, N. D. Public Service Commission and BLM representatives shall collectively determine areas to be reclaimed to native conditions and/or cultivation.

6. Seeding and planting composition, rates, and other revegetation criteria will also be determined following regrading.

7. Seeding will be done as instructed until it has been determined successful by BLM and N. D. Public Service Commission.

8. Where an excavation is to be left as a permanent water impoundment, suitable accesses should be provided for people, wildlife and livestock.

9. Disposition of any final highwall shall be determined after consultation with the U. S. Geological Survey, BLM, North Dakota Public Service Commission, and the mining company.

10. To prevent or abate environmental pollution, any excessive amounts of pollutants will be prevented from reaching the air, water, or land resources, including surface water sources and ground water aquifers (subsurface strata through which ground water moves). "Excessive amounts" of pollutants means any amount which exceeds

the maximum amount permitted by the Federal Water Pollution Control Administration, National Air Pollution Control Administration, and by the appropriate agency of the State of North Dakota.

11. Haul roads shall be constructed to the minimum width necessary for efficient and safe operations. Haul roads must have adequate drainage and be constructed consistent with good watershed practices. Haul roads shall be sprinkled with water at time intervals necessary to reduce air pollution from dust. Haul roads shall be located, is so far as feasible, so as not to interfere with proper shaping of spoilpiles. Haul roads may double as access roads.

12. Dams, ditches, dikes, and canals used for surface water control in and around the mining operation shall be constructed in accordance with approved engineering practices and located so as to do the least amount of environmental damage. Soil material shall be placed on all dams and dikes following construction. These and all areas denuded during construction of water control structures shall be seeded after placement of soil material.

13. All drainage waters discharged into natural drainages must meet State and Federal water quality standards. Waters which enter the pit or overburden areas must meet State and Federal test requirements, prior to discharge into natural drainages. If necessary, they shall be impounded for chemical treatment and sediment disposal.

14. All operations shall be conducted so as to avoid range and forest fires and spontaneous combustion. Open burning of carbonaceous materials shall be in accordance with suitable practices for fire

prevention and control. The mining company shall take immediate steps to extinguish any fires in piles of coal wastes or slack, or in an exposed face of in-place coal.

15. The active mining areas shall be posted, fenced, or otherwise protected where necessary to minimize injury to people, livestock, and wildlife.

16. Drill holes shall be temporarily protected at all times so as to prevent injury to people, livestock, and wildlife. They shall be permanently sealed when the need for the drill hole no longer exists.

17. All existing improvements, including but not limited to gates, cattleguards, roads, trails, pipelines, bridges, public land survey monuments, and water development and control structures, shall be replaced, restored, or appropriately compensated for as soon as practicable in the event they are damaged or destroyed by company operations.

18. Surface buildings, supporting facilities, haul roads, and other structures that have served their purpose shall be removed and the area shall be graded and revegetated.

19. Flowing springs, wells, and reservoirs which are eliminated by mining shall be replaced with suitable alternative water developments.

20. If an archaeological or historical site is discovered during mining, operations shall immediately cease and the BLM District

Manager and other appropriate authorities shall be notified. A reasonable time will be allowed for evaluation or removal of these values.

21. The lessee will be required to comply with all State laws and regulations concerning coal mining.

As mentioned earlier, Consolidation Coal Company has applied for leases on 1,922.44 acres of Federal coal. This earlier application was the subject of an Environmental Analysis Record (December, 1973) which recommended that 320 acres be leased, and the rest of the area not leased until an Environmental Impact Statement (EIS) is prepared. The 320 acres were offered for lease, but were not bid on. The Bureau of Land Management has recently received authorization to prepare a Regional Impact Statement covering the lease of these 1,922.44 acres and all other coal development activities in the adjoining area. This EIS will require a preparation period of longer length than can be allowed for with this action. Any delay in acting on the application may result in the coal being bypassed. Consequently, this Environmental Analysis Record is being made to provide the decision maker with the environmental information necessary to process the lease of that Federal coal needed by the applicant until an Impact Statement can be prepared.

Upon completion of this environmental analysis record, the Miles City BLM, District Manager must make a recommendation regarding the need for an Environmental Impact Statement (EIS) on the subject 480 acres. This recommendation is made to the BLM State Director, BLM Director in Washington, D. C., and Department of the Interior officials.

If an EIS is not recommended, the District Manager uses this environmental analysis and a technical report in accordance with part 23 Code of Federal Regulations, and recommends favorable or unfavorable action on the proposed lease amendment. If the recommendation is favorable, stipulations are prepared for the proposed lease amendment and forwarded to the BLM State Director.

The U. S. Geological Survey reviews the stipulations, and any technical conflicts are resolved prior to forwarding to the Director, BLM, in Washington, D. C. The lease is reviewed and forwarded to Department of the Interior officials for final action.

CHAPTER 2

DESCRIPTION OF THE ENVIRONMENT

CLIMATE

No one climatic factor acts alone to create an area's climate. Temperature, precipitation, humidity, wind velocity and direction, atmospheric pressure, solar and terrestrial radiation, and snow cover all have important interrelationships.

The climate of the Stanton area is continental in nature with hot summers, cold winters, and low humidity. The Rocky Mountains, west of the Dakota's, act to modify the prevailing westerly flow of air originating in the Pacific Ocean. Because there are no barriers with respect to air mass movement from source regions in the polar region or the Gulf of Mexico, air masses originating in those regions flow easily over the area, with only minor changes in their basic characteristics. The rapid progression of air masses from the different sources results in frequent and rapid changes in the weather.

No long periods of wind records exist in the Stanton area. Therefore, the records of four nearby National Weather Service Stations were used to obtain an interpolated picture of wind behavior in the Stanton area.

A summary of the wind records from Bismarck, Minot, and Stanton are shown in Appendix 2, Figure A2-1. (Report by Dames and Moore for Natural Gas Pipeline Company of America.) Data from Stanton is from only one year of records (1972) provided by the Basin Electric Power Plant. It is apparent from these wind roses that northwest winds prevail most often in west-central North Dakota.

In an attempt to obtain the probable wind behavior in the area, the data from four surrounding wind stations (Bismarck, Williston, Dickinson, and Minot) were combined and displayed in Appendix 2, Figure A2-2. (Report by Dames and Moore for Natural Gas Pipeline Company of America). The prevailing wind directions by month show that northwesterlies prevail during fall and winter (September through March). In the spring and summer, southeasterly winds prevail. Average wind speeds vary from 8 to 13 miles per hour (mph) with the highest speed recorded at 72 mph.

Winter cold fronts and low pressure systems can produce winds of about the same speed as those associated with summer thunderstorms. High winds in winter can be sustained over a period of several hours, and in rare cases two to three days. In the summer the duration of strong winds is usually on the order of a few minutes.

The nearest stations with long term data are at Center, located 10 miles south at an elevation of 2,100 feet above mean sea level (MSL); and Washburn, located 15 miles east at an elevation of 1,790 feet above MSL. Normal temperatures at Center range from a mean of 08.5^{o} F. in January to 69.0^{o} F. in July; the range at Washburn is 09.3^{o} F. in January to 70.8^{o} F. in July. More realistic of the extreme variations in temperature, are the highs and lows reported during the year 1975 at Center: 103^{o} F. on July 29 and -23^{o} F. on December 18.

The average length of frost free periods in the Stanton area is 120 days. The first freeze can be expected in the fall about September 16. The last freeze occurs about May 20. (Jensen 1972). The period between killing frosts, that is when the temperature falls below 28° F., is about 150 days. Very few crops are ever injured by frost.

The average mean precipitation at Center is 17.83 inches. More than 77% of this amount falls from April through September and 48% falls in May, June, and July. Most summer rainfall occurs as thunderstorms in the late afternoons and evenings. Winter precipitation is light and nearly always occurs as snow. The following table shows the annual average precipitation for the period 1941-1970.

Table 2-1

AVERAGE PRECIPITATION

	Inches
January	.53
February	.58
March	.85
April	1.54
May	2.42
June	3.55
July	2.59
August	2.05
September	1.65
October	.85
November	.74
December	.48

AIR QUALITY

Air sampling stations have been established throughout North Dakota. One (Stanton) is within two miles of the proposed lease site, another (Washburn) is located approximately 15 miles east of the site.

Both sites collect and analyze air samples for three pollutants; total suspended particulates, Sulphur dioxide (SO_2), and nitrogen dioxide (NO_2). Suspended particulates, or fugitive dust, are sampled using a high-volume sampler. The other pollutants are sampled using gas bubblers. The data in Table 2-2, below, represents samples taken for the period of April through December 1975. Although it does not represent a complete year, it does give an idea of the quality of air in the area with respect to the pollutants sampled, and is the only currently available information specific to the site.

The State of North Dakota has established ambient air quality standards. For particulates the standard is 60 ug/m^3, maximum annual geometric mean and 150 ug/m^3, maximum 24-hour concentration not to be exceeded more than once per year. It appears that the dust level is a function of seasonal winds and exposed agricultural lands. The SO_2 ambient standard is 60 micrograms per cubic meter of air (0.02 ppm), maximum annual arithmetic mean, 260 micrograms per cubic meter of air (0.10 ppm), maximum 24-hour concentration, 715 micrograms per cubic meter of air (0.28 ppm), maximum 1-hour concentration. The ambient standard for NO_2 is 100 micrograms per cubic meter of air (0.05 ppm), maximum arithmetic mean, 200 micrograms per cubic meter of air (0.1

ppm), maximum 1-hour concentration not to be exceeded over 1 percent of the time in any 3-month period. The data does not reflect any point where pollutant concentrations exceeded these standards. It can be concluded, based on the available information, that dust is currently the biggest pollutant.

TABLE 2-2

MONTH - 1975	TOTAL SUSPENDED PARTICULATES*	SO_2*	NO_2*
April	14/14**	3/3	1/1
May	41/42	5/6	4/12
June	29/28	10/15	4/5
July	57/57	4/8	6/2
August	36/49	11/9	4/3
September	35/45	0/0	1/12
October	17/14	0/0	3/2
November	36/28	0/0	6/2
December	23/11	3/0	6/0

* Measured in ug/m^3 (micrograms/cubic meters).

** Stanton/Washburn

GEOLOGY

Stratigraphy

Rocks of four formations, ranging in age from Tertiary to Holocene, are exposed in the general area (see the geologic map in Figure A2-3, Appendix 2). In ascending order, they are the Tongue River-, Sentinel Butte-, Coleharbor-, and Walsh Formations. A complete stratigraphic column of the rock units for Mercer and Oliver Counties is given in Figure A2-4 in Appendix 2.

The Tongue River Formation of Paleocene age (about 60 million years old) is the oldest formation exposed near the mine. This non-marine formation contains the lignite beds that are being mined. Carlson (1973) described this formation as being about 375 to 450 feet thick (where the entire formation is present) and consisting of interbedded sand, silt, clay, shale, lignite, and limestone, but predominantly silt and clay. Two persistent sandstones occur in the stratigraphic section. The most persistent of the two is about 40 feet thick and forms the basal unit of the formation. The various beds weather to light colors, generally shades of yellow, gray, and brown. The limestone occurs as yellowish gray, lense-like bodies rather than true beds. Because of the limestone's resistence to erosion, these bodies usually cap knobs, ridges, and benches (Carlson, 1973). Brownish gray, carbonaceous shales are usually closely associated with the lignite beds. The lignite bed stratigraphy in these counties is incomplete and further study and correlation of the stratigraphy of this formation is necessary. Early studies (Benson, 1952; and Johnson and Kunkel, 1959) were hampered by the lack of topographic and subsurface controls. Carlson (1973), aided by more topographic and subsurface data, felt that he could position the lignite beds closer to their proper stratigraphic positions, but much more geologic work is necessary. Much of the geologic information given below was abstracted from Carlson (1973) unless otherwise indicated.

The Sentinel Butte Formation conformably overlies the Tongue River Formation. It is also of Paleocene age and consists of interbedded sand, silt, clay, shale, limestone, and lignite. The beds of this formation tend to weather to darker gray and brown shades than do those of the Tongue River Formation. Color alone is not enough to differentiate these formations. The Sentinel Butte Formation reaches a maximum thickness of about 350 feet in this region. Only a thin veneer is preserved along the drainage divides in the western part of the mine area.

The Golden Valley Formation that comformably overlies the Sentinel Butte Formation several miles west of Stanton is not present in the mine area.

Unconsolidated glacial sediments of the Coleharbor Formation of Quaternary age (Pleistocene) comprise the surface materials in a large portion of the mine area. The basal unit of this formation consists of a ground moraine landform that is composed of glacial till made up of unsorted clay, silt and sand interspersed with pebbles, cobbles, and boulders. An overlying unit, known as the Gravel Facies, occurs northeast of the mine area in the Missouri River floodplain. It consists of variably sorted accumulations of gravel. This glacial facies was laid down either as ice contact or outwash landforms. An upper unit of the Coleharbor Formation, known as the Sand Facies, occurs as terrace deposits northeast to east of the mine area. These terrace deposits consist of generally well sorted, fine to medium grained sand, often associated with some gravelly sand.

Four units of the Walsh Formation of Holocene age (Recent) are present in the Stanton area. One unit, consisting of well sorted, fine to medium grained sand forms large sand dunes north to northwest of the mine area. Two of the remaining three units of the Walsh Formation form the lower and upper terrace landforms along the Missouri River. The fourth unit as identified by Carlson (1973), forms alluvium-floodplain, terrace or lowland deposits along the valley bottoms of the main-trunk tributaries to the Missouri River. The latter three mappable units of the Walsh Formation consist of similar sediments-dark brown, gray or black silt, clay, and sand.

Structure

The mine area is located in the southeastern part of the central Williston basin. The center of this broad structural basin is situated south and east of Williston, North Dakota. Few faults occur in the bedrock of the region. The major structural features in the area consist of small landslide and slump features, primarily in clay-rich sedimentary rocks. The regional dip of the rock units is westward. However, locally, the dip is low (often less than 1°) and varies from north to northeast.

Coal Beds

Two minable beds of the Tongue River Formation occur in the lease area. These lignite beds are separated by 20 to 50 feet of interburden material.

The lower seam, known as the Hagel bed (Carlson, 1973), was previously described as being the Stanton bed (Benson, 1952; and Johnson and Kunkel, 1959). The Hagel bed varies from 6 to 10 feet thick throughout the lease area. The base of this lignite bed occurs at an elevation of approximately 1,850 feet above sea level or about 275 feet above the base of the Tongue River Formation. The Hagel bed is the primary commercial bed in the Glenharold Mine. It will be presently mined down to a maximum of about 140 feet of overburden.

The upper bed, known either as the Berg bed (Johnson and Kunkel, 1959) or the Local bed (Benson, 1952) ranges from 4 to 7 feet thick in the lease area. In the mine area, this bed may have up to 3 splits (benches). The economics of mining are such that only those split seams with a thickness of 3 feet or more are mined. Local splitting determines whether all, part, or none of the upper bed is recovered during stripping of the underlying Hagel bed.

In the N½N½, Section 32, T. 144 N., R. 84 W., the upper bed is about 4 feet thick. It is separated from the underlying Hagel bed (about 7 feet thick here) by about 20 to 25 feet of interburden. In Section 19 of the same township, only the lower of 3 splits of the upper bed is mined (see Figure A2-6).

Thin or otherwise noncommercial lignite beds are present in the Tongue River Formation both above and below the upper and Hagel beds. Carlson (1973), using drill hole data gathered 3 miles west of the Glenharold Mine, identified two lignite beds underlying the Hagel bed: (1) a 6 foot bed, 30 feet below the Hagel bed and 245 feet above the base of the Tongue River Formation; and (2) a 5 foot bed 110 feet below the Hagel bed and 170 feet above the base of the Tongue River Formation.

The coal currently being mined in the area averages 6,800 BTU, 0.5% sulfur, and 5% ash. The reserves of federal coal in the proposed lease modification are listed in Table 2-3 below.

TABLE 2-3

ACREAGES AND RESERVES OF FEDERAL COAL IN THE PROPOSED LEASE MODIFICATION 1/

Acres of Total Reserves 2/	Total Reserves 3/ (Tons)	Acres of Strippable Reserves 4/	Total Strippable Reserves 5/ (Tons)	Total Recoverable Reserves 6/ (Tons)
454.89	9,552,690	414.72	8,709,120	7,838,208

1/ The acreage figures were calculated, using the dot-count method, from the mining plan (map no. 2) provided by the company.

2/ This acreage figure includes the original 480 acres minus 25.11 acres estimated to be below the Hagel lignite bed.

3/ Calculated by: (1) multiplying the total reserve acreage by an estimated cumulative average lignite thickness of 12 feet to obtain the volume of coal in acre-feet. This figure was then multiplied by 1,750 tons/acre-foot (the average weight of lignite coal - Averitt, 1974) to yield the total reserve tonnage.

4/ This acreage figure includes the original 480 acres minus 65.28 acres where the lignite is lacking or the overburden thickness is too great for economical recovery at the present time.

5/ 414.72 acres X 12 feet of coal = 4976.64 acre-feet;
4976.64 acres-feet X 1,750 tons/acres-feet =

6/ This tonnage is obtained by multiplying the total strippable reserves by a recovery factor of 90%.

Overburden Characteristics

The stratigraphic section described by Johnson and Kunkel (1959) show that the overburden material in the mine area is mainly shale interbedded with minor thin beds of sandstone. Glacial till up to 40 feet thick overlies this shale-rich overburden material on about one-third of the mine area (Carlson, 1973).

Johnson and Kunkel (1959) state that the shales are either light to olive gray, yellowish-brown, or black. The brownish tones occur in a weathered or oxidized zone. Particle-size analyses indicate that the spoils are dominantly clay-sized with lessor amounts of sand- and silt-sized material (Sandoval, et al, 1973). Smectite clay minerals dominate the minerology.

The glacial till consists of a compact, relatively impervious mixture of unconsolidated particles ranging in size from clay to boulders. The matrix of the till is characteristically clay-rich and calcareous (Benson, 1949).

Chemical analysis of overburden collected from spoil piles at the Glenharold Mine indicate that the spoil material is alkaline (pH about 8.3), quite sodic, slightly saline, with soluble salt concentrations dominated by sodium sulfate (Sandoval, et al, 1973). These authors also found that analyses of undisturbed overburden taken at various depths indicate that: (1) soluble nitrate concentrations are low; (2) exchangeable ammonium contents are negligible near the surface, but show a marked and progressive increase below depths of 20-30 feet; (3) the sodium absorption ratio increases with depth; and (4) the alkalinity is relatively constant with depth except in lignitic zones which are slightly acidic.

Paleontology

Fossils enclosed in the sedimentary rocks in this area are both scarce and insignificant (in their collectable value). The most significant fossils are the occasional complete leaf imprints found in the clinker beds.

TOPOGRAPHY

The mine area occurs within the Glaciated Missouri Coteau section of the Great Plains physiographic province. The topography is mainly pre-glacial in character, and is mapped on U.S.G.S. 7.5 minute quadrangle - Stanton SE, North Dakota (see Figure A2-5, Appendix 2). The major drainages and their tributaries are pre-glacial bedrock valleys cut into the underlying Tongue River Formation (Carlson, 1973).

The mine area is situated between a broad, gently rolling upland plateau on the southwest and the low-lying, flat Missouri River flood plain on the northeast. The mine itself occurs primarily on "breaks" type topography, a landform herein termed "dissected plateau". This dissected plateau rises rather abruptly 310 to 430 feet above the Missouri River flood plain. Elevation in the mine area varies from about 1,780 feet to 2,080 feet, with an overall average of about 1,900 feet above sea level. A maximum of about 300 feet of local relief separates the gently rolling upland surfaces of the dissected plateau from the relatively steep-walled, narrow drainages that dissect the area. These drainages or valleys combined to form a dendritic drainage pattern carved out by headward erosion of the intermittent streams which occupy them. The main direction of drainage in the mine area is north-northeast. Alderin Creek, located just south and east of the proposed lease tracts (see Figure A2-5, Appendix 2), is the main drainage. It trends east and then northeast for a distance of about 2 miles before joining the Missouri River.

The topography is divided into 6 distinct landforms for the purposes of this report. These landforms - flood plain, alluvial terraces, sand dunes, dissected plateau, and plateau-are naturally occurring segments of the local landscape, with the exception of "mined land" which includes man-made features. The landforms are delineated on Figure A2-6, (Appendix 2), which is a generalized physiographic cross section of the area. Each landform is discussed individually below (modified after Carlson, 1973).

Flood Plain

The flood plain landform consists of lowland deposits along the bottom of Alderin Creek and along the margins of the Missouri River. The lithology of this landform consists of dark brown, gray or black silt, clay, and sand of the Walsh Formation.

Alluvial Terraces

The alluvial terrace landform occurs along the northeast margin of the mine area, situated between and slightly above the flood plain landform previously described and the dissected plateau landform. These terraces generally consist of well sorted, fine to medium grained sand to gravelly sand of the Sand Facies of the Coleharbor Formation.

Sand Dunes

The sand dunes landform occupies an extensive region immediately north-northwest of the mine area to just south and west of Stanton. It consists of flat lowlands on which gentle-sloped sand dunes and shallow depressions occur. The local relief is very low and varies from

10 to 30 feet. This landform generally occurs on the lee side of the alluvial terrace landforms previously described. The prevailing northwest winds picked up the fine to medium sand grains from the alluvial terraces and deposited them on the lee side to form the sand dunes landform.

Dissected Plateau

The dissected plateau landform forms the "breaks" or dissected uplands that rise abruptly above the flood plain landform. This landform consists mainly of gently sloping upland topography underlain by bedrock. Stream erosion (or gullying) has led to the formation of this rather rugged topography. Local relief is quite high and reaches a maximum of about 300 feet in the mine area. Much of the mine is located on this landform. Thin deposits of glacial till, forming ground moraine landforms, occur over roughly half of this landform in the mine area.

Plateau

The plateau landform is a broad gently rolling upland area consisting of bedrock topography largely modified by an overlying thin veneer or blanket-type deposit of glacial till. Local relief is low. The elevation varies from about 2,000 feet to 2,100 feet above sea level. The dissected plateau landform, previously discussed, was derived from this landform through the erosive action of intermittent streams.

Mined Area

The mined area landform consists of that portion of the area that has already been disturbed by strip mining. These man-made landforms consist of open cuts, highwalls, spoil piles, topsoil piles, haul roads, and reclaimed areas.

WATER

Surface Water Characteristics

The mine area is located in the Missouri River drainage basin below Garrison Dam and Lake Sakakawea. The mine is located in an area of old plateaus and terrace lands overlooking the Missouri River.

Nearly all the annual rainfall occurs in the spring and summer, during which time, major stream (Alderin Creek) flows are continuous. During the rest of the year, the streams flow intermittently. The median annual runoff in the area is about 76.8 acre feet per square mile or about 1.44 inches per acre annually, which all flows into the Missouri River. Most of the intermittent stream flow around the mine occurs during the spring and summer following frequent thunderstorms (Jensen).

The drainage system throughout the area is consequent in nature. Drainage of the area north of the mine is in a northerly direction and flows directly into the Missouri River via a small unnamed tributary. Drainage to the south of the mine area is in a northeasterly direction and flows into Alderin Creek, a small intermittent stream that empties into the Missouri River near the Fort Clark Historic Site.

The surface water quality of this portion of the Missouri River is fairly stable because of the relatively constant release of water from Garrison Dam. During an average year, around 20,500,000 acre feet of water is released. The water appears to be a sodium bicarbonate type, low in total dissolved solids (TDS), 412-470 milligrams per litre (mg/l) when compared to other water sources in the area (see Table A2-1).

Water flows into the mine area intermittently as a result of seasonal precipitation and ground water inflow into the mine pits. This water is pumped intermittently from the pits at a rate of from 150 to 375 gpm (gallons per minute) into sedimentation ponds. The water from these ponds is then allowed to evaporate. Currently, there are two such ponds in the mine area, with plans to construct four additional ponds this summer (Consolidation Coal Company, personal communication). The quality of this discharged water is poorer than the surface water of the Missouri River, but approximates the ground water quality of Mercer and Oliver Counties. Within the mine area, this water is high in sodium, ranging from 430 to 850 mg/l; very high in total alkalinity, ranging from 790 to 1,530 mg/l; and has a low to very high range of sulfates. This discharge water is unsuitable for irrigation purposes, and could prove harmful to all, but the most tolerant of plants (Consolidation Coal Company, personal communication).

Ground Water Characteristics

Water in aquifers fluctuates in response to recharge and discharge. Changes in atmospheric pressure and land-surface loads can also cause minor water level fluctuations. Recharge to ground water aquifers is due largely to underflow or subsurface inflow. The amount of water available for recharge to the shallow aquifers is only a small portion of the total precipitation received annually, the remainder is due largely to infiltration from numerous surface water sources. Discharge of ground water usually appears as springs and seeps along major river valleys (Croft 1973).

Ground water contains dissolved mineral matter in varying degrees. The amount and kind of dissolved materials depends upon the solubility and types of rocks encountered, the length of time the water was in contact with the rocks, and the carbon dioxide and soil acids in the water.

Major ground water aquifers occur in geologic units of Cretaceous and Tertiary age which underlie the mine area. These aquifers are named after the formation(s) or portion of formation(s) which contains them as shown in Table A2-2 (i.e.; (1) the Fox Hills and Basal Hell Creek aquifer; (2) the Upper Hell Creek and Lower CannonballLudlow aquifer; (3) the Lower Tongue River aquifer; and (4) the Sentinel Butte aquifer. Generally the aquifers used for water supplies are located above the Fox Hills formation. For practical purposes, the Fox Hills forms the base of the fresh water bearing units in the area (Croft 1973).

The Fox Hills and Basal Hell Creek aquifer consists of fine to medium grained sandstone beds interbedded with some siltstone and claystone. The aquifer is from 150 to 370 feet thick and has a relatively low hydraulic conductivity. A number of artesian wells flow from this aquifer at a rate of 10 to 25 gallons per minute (gpm). When wells tapping this aquifer are pumped, they will yield from 25 to 150 gpm (Croft 1973). Water quality tests of this aquifer (see Table A2-3) indicates the water is a sodium bicarbonate type suitable for livestock, most domestic purposes, and some industrial uses. The water is not recommended for irrigation because of the high sodium-absorption ratio and a TDS of 1,230 to 1,990 ppm.

The Upper Hell Creek and Lower Cannonball-Ludlow aquifer consists of fine grained sandstone interbedded with siltstone and claystone. Artesian wells tapping this aquifer flow at a maximum rate of 25 gpm. When wells tapping the aquifer are pumped, they can produce up to 100 gpm. The aquifer is from 70 to 150 feet thick and about 320 feet deep. Generally the artesian wells are located in low areas such as stream valleys (Croft 1973). Water quality of this aquifer (see Table A2-4) indicates the water is a sodium bicarbonate type and has a TDS of 1,510 to 1,890 ppm. The water is acceptable for livestock and some domestic use, but is not suitable for irrigation because of its very high sodium absorption ratio. (Croft 1973).

The Lower Tongue River aquifer consists of fine to medium grained sandstone interbedded with siltstone and claystone beds. The aquifer is less than 150 feet thick, 300 to 600 feet deep and has a low hydraulic conductivity. Very few wells tap this aquifer. Those that do yield from 5 to 50 gpm. This water is used primarily for livestock and some domestic supplies (Croft 1973). Water quality tests of this aquifer (see Table A2-5) indicates the water to be a sodium bicarbonate type, a TDS of 1,400 to 1,930 ppm, and an excessive amount of iron. The water is suitable for livestock and some domestic use, although it is not too desirable. It is not recommended for irrigation because of its high sodium absorption ratio. (Croft 1973).

The undifferentiated lignite aquifers in the Tongue River- and Sentinel Butte formations, produce water from fractures and joints in the lignite beds. Most wells tapping these aquifers produce about 10 gpm. These aquifers are small and fluctuate according to the season (Croft 1973). Water quality tests of this aquifer (see Table A2-6) indicates the water has a TDS of 1,050 to 1,810 ppm and an iron content of 3.3 to 3.6 ppm. Water from this aquifer is commonly reddish brown in color because of its high organic content. (Croft 1973).

SOILS

Most of the soil data in this chapter and in the appendix came directly or indirectly from the Soil Conservation Service's unpublished Mercer County Soil Handbook and their unpublished soil survey field sheets.

The soils of Consol's Glenharold Mine area are forming in a variety of parent materials and geologic formations. The silty Mandan, Wilton, Temvik, and Williams soils are forming in calcareous loess over glacial till. Geologically, they are young soils. The Regent, Rhoades, and Cabba soils are forming in interbedded loam, silt stone, and clayey shales,on the much older Tongue River formation. The Cabba soils are quite young due to steep slope instability. The Regent and Rhoades are older more highly developed soils and contain sodium. The Ringling series is forming in "fire baked" materials called scoria.

Soil mapping (by the Soil Conservation Service) was done on aerial photographs at a scale of four inches per mile. Soils were identified and mapped at the series and type level, which is the most specific level of soil identification. Nine soil series were identified, and ten soil units were mapped over Federal coal in the mine area. (See Appendix 2, pages A2-16 through A2-25 for descriptions of the soils, soil maps, tables of characteristics and properties and the soil series classification).

The Regent, Mandan, Temvik, and Williams soils are well suited for final cover of strip mined lands. Of the 440 acres of United States owned coal, these soils overlie about 170 acres or 40% of the area. The

Rhoades soil, due to a high SAR (Sodium Adsorbtion Ratio), is poorly suited as topsoil, but it is only mapped in complex with the Regent series. The Cabba and Ringling soils, which are poorly suited as topsoil, are very shallow and usually occur on steeper slopes. They are mapped on about 270 acres and make up approximately 60% of the area.

VEGETATION

The climax (final or mature community) terrestrial vegetation of the Glenharold Mine area belongs to the broad, grassland biome (Oosting, 1956; Odum, 1959). The Stanton, North Dakota, area belongs in the mixed-grass prairie lifeform region. It is described by Küchler (1964) as being characterized by the wheatgrass-needlegrass (Agropyron spp. - Stipa spp.) and northern floodplain forest (Populus spp. - Salix spp. - Ulmus spp.) vegetation formations (ecosystems). These broad descriptions provide a regional overview, but are not definitive enough to characterize each plant community in the lease amendment area. The U.S. Soil Conservation Service (SCS) has mapped and described the soils of this area, including range site descriptions for each soil type (SCS, 1974). These range site descriptions and a schematic diagram showing their occurrence on the proposed coal lease area are shown in Appendix 2.

The following vegetation classification system (patterned after "Ecoclass"; Corliss and Pfister, et.al., 1973), utilizing primarly the basic information of the U.S. Bureau of Land Management's (BLM) Oliver-Mercer Unit Plan (Montgomery, 1975a) and Stewart's habitat descriptions (Stewart, 1975), was used to separate and classify the natural vegetative resources of the mine area:

Riparian (streambank) Hardwood Forest Region

Prairie Woodland Thicket Region

Steppe (treeless plain) Grassland Region

Wheatgrass (Agropyron spp.) Series

Bluestem - Sandreed (Andropogon spp. - Calamovilfa spp.) Series

Needlegrass (Stipa spp.) Series

Additionally, several vegetation complexes resulting from human disturbance are found on the mine area. These vegetation complexes were classified as:

- Agricultural types
  - Croplands
  - Retired lands
- Disturbance Sites
  - Mine Spoils and Facility Sites
  - Roads and Farmsteads

Riparian Hardwood Forest Region

This vegetation region is largely confined to the undisturbed annual floodplain and recent terraces of perennial and relatively large intermittent streams of the area. Burgess, et.al. (1973) have documented and presented a comprehensive account of this vegetation region as it appears along the Missouri River bottom. The characteristic vegetation typically occurs on sites of low relief (flat). The flora (plants) of this region are characterized by an overstory of cottonwood (Populus spp.) and willow (Salix spp.) representative of early successional stages, and American elm (Ulmus americana), boxelder (Acer negundo), and green ash (Fraxinus pennsylvanica) representative of later seral stages.

The principle tall shrub overstory plants are: buffaloberry (Shepherdia argentea), willows (Salix spp.), serviceberry (Amelanchier alnifolia), red-osier dogwood (Cornus stolonifera), hawthorn (Crataegus spp.), snowberry (Symphoricarpos spp.), and rose (Rosa spp.). The understory is characterized by western wheatgrass (Agropyron smithii), green needlegrass (Stipa viridula), big bluestem (Andropogon gerardi) and Kentucky bluegrass (Poa pratensis).

This vegetation region is present along the Missouri River bottom in this area and extends into the lower reaches of some of the tributary drainages in the Glenharold Mine area. This floral complex is not present on any of the proposed coal lease tracts, however.

Prairie Woodland Thicket Region

This vegetation region develops in narrow drainages and small draws with comparatively moist microclimates, including shallow swales, well-drained depressions, north and east facing slopes of morainic hills and river bluffs. This region sometimes occurs as an extension of the Riparian Hardwood Forest Region. Most of these plant complexes are dominated by a mixture of small trees and tall shrubs. Prominent species include: green ash, American elm, boxelder, snowberry, chokecherry, buffaloberry, wild plum (Prunus americana), hawthorn, skunkbush sumac (Rhus trilobata), silverberry (Elaeagnus commutata), western wheatgrass, green needlegrass, and fringed sage (Artemisia frigida). This vegetation region occupies approximately 105.6 acres (22%) of the surface acreage overlying the proposed coal lease. It coincides closely with the shallow range site category of the SCS mapping for this area (Appendix 2).

Steppe Grassland Region

This vegetation region prevails on the relatively exposed and dry sites throughout the area. It is the major vegetative association in this physiographic region. The natural vegetation is generally characterized by taller growing mid-grass with an understory of shortgrasses, sedges, and forbs. Some low-growing shrubs occur at localized sites where conditions are favorable. This plant region is relatively variable and reflects a wide range of microclimates and edaphic conditions. Several distinct series are prevalent in this vegetation region.

Upland Grassland Series

This series constitutes approximately 217 acres (45.2%) of the surface lands overlying the proposed coal lease. It is typically found on the drier sites in relatively steep, broken uplands of the dissected plateau. The series is often intermingled with the Prairie Woodland Thicket Region. Western wheatgrass, junegrass (*Koeleria cristata*), needle-and-thread (*Stipa comata*), and to a lesser extent, little bluestem (*Andropogon scoparius*) and prairie sandreed grass (*Calamovilfa longifolia*) are the characteristic grasses of this series. A variety of forbs may be found in this series. This region coincides closely with the silty and clayey range sites as defined by the SCS. The soils are usually fertile, and relatively well drained with moderate to low permeability.

Rolling Grassland Series

This series is not found on any of the lands overlying the proposed coal lease, although it does occur in the Glenharold Mine area. It is typically found on the gently undulating and long sloping uplands (i.e. gently sloping drainage divides, ridges and larger hills, and lake plains). Characteristic plants of this series include western wheatgrass, junegrass, blue grama (Bouteloua gracilis), threadleaf sedge (Carex filifolia), and in some interspersed locations, prairie sandreed grass and little bluestem. A variety of forbs occur in this series, and in some locations, xeric shrubs are present. The soils of this vegetation series are variable.

Shifting Grassland Series

This series occurs on the north end of the Glenharold Mine area, but is not present on proposed lease tracts. This series is typified by deep, loose, coarse-textured soils on nearly level to rolling uplands and stream terraces derived from eolian sands that were part of a glacial outwash. This area is highly susceptible to wind erosion, and consequently, is very unstable. The principle overstory vegetation includes quaking aspen (Populus tremuloides), plains cottonwood (Populus deltoides), willows, snowberry, rose, and buffaloberry. Characteristic grasses are sand bluestem (Andropogon hallii), prairie sandreed grass, needle-and-thread, Indian grass (Sorghastrum nutans), and sand dropseed (Sporobolus cryptandrus). A variety of forbs are found in this series.

Agricultural Region

This region is comprised of two artificial, man-induced vegetation complexes.

Cropland Series

Approximately 74.8 acres (15.6%) of the surface lands overlying the proposed lease are in this series. The series has been established at the sacrifice of native grasslands. This is the case in the N½N½, Section 32 where a flax field presently exists. Cropland fields are represented by various development stages from bare fallow through mature crops to stubble fields. Various species of invading annual weeds are usually present in these fields.

Retired Land Series

This series contributes approximately 42.3 acres (8.8%) of the surface lands overlying the subject federal coal tracts. The SW¼SE¼ of Section 20 is predominantly retired lands. These lands consist of former croplands that have been abandoned for various reasons, and are allowed to naturally revegetate or seeded to legumes and domestic grasses. These include smooth brome (Bromus inermis), crested wheatgrass (Agropyron cristatum), intermediate wheatgrass (Agropyron intermedium), alfalfa (Medicago sativa), and sweetclover (Melilotus spp.). Many pioneering "weed" (forb) species invade these fields also.

Disturbed Sites

This type is comprised of a variety of pioneering plant communities in various successional stages. They appear along roadsides, farmsteads, mine facilities, and in "reclaimed" mine spoils. The vegetation species on these sites are variable and a product of the past surface treatment. On these sites no characteristic vegetation complex is definable.

Wetlands

Three man-made wetlands (stockwater ponds) occur on the proposed coal lease area. Each pond could be classified as Type 5 (Inland Open Fresh Water) using the classification system of Shaw and Fredine (1971). One reservoir (estimated 2 acres in size) occurs in the NW¼SE¼, Section 20 (see photo in Appendix 2). This reservoir occurs in a heavily grazed pasture and has very little shoreline vegetation. The second reservoir (estimated <1 acre in size) occurs in the SE¼SE¼, Section 30, near the head of a coulee in a livestock pasture. Very little shoreline vegetation occurs around this pond. The third reservoir (estimated <1 acre in size) occurs in the N½NW¼ Section 32 (see photo in Appendix 2). This reservoir occurs along a woody draw and is heavily surrounded by trees and shrubs on all sides.

Endangered or Threatened Plant Species - Relict Areas

The SCS describes sites of climax vegetation that have not been disturbed by man, either through grazing or any other means, as "relict areas". Since the entire Glenharold Mine area has been subject to agricultural practices for many years, it is doubtful that any relict areas are present.

Three species of plants in North Dakota are considered "candidates" for listing as endangered or threatened species. These three species are Yellow Marsh Cress (Rorippa calycina), Small White Ladyslipper (Cypripedium candidum), and Prairie Fringed Orchid (Platanthera leucophaea). Occurrence of these species in the Glenharold Mine area is undetermined at this time. Dr. William Barker of North Dakota State University has conducted an intensive analysis of plant historical records of North Dakota (Barker, et.al., 1976). He contends that North Dakota has no "endangered" species, as such, but that several species could be considered "rare" or "unique" within the North Dakota state boundaries. An annotated list of 130 species considered "rare" or "unique" in North Dakota has resulted from this research study. Some of these species could feasibly occur in the Glenharold Mine area, although this is undetermined at present.

ANIMALS

Little site-specific information exists regarding the native wildlife and habitat relationships in the Glenharold Mine area. In 1973, the U. S. Bureau of Land Management (BLM) conducted an environmental analysis of a 2,000 acre coal lease application by Consolidation Coal Company at the Glenharold Mine. Some habitat analysis was conducted at that time (BLM, 1973). In 1975, the BLM developed a unit resource analysis (URA) for the Oliver-Mercer Planning Unit (Montgomery, 1975b). This analysis is quite comprehensive; but, by design, rather general in nature. Woodward-Clyde (1975) conducted an intensive environmental analysis of the ANG coal gasification project site near Beulah in Mercer County. This site lies approximately 20 miles west-northwest of the Glenharold Mine. Bovee (1975) presented the results of aquatic relationship studies conducted in the Northern Great Plains Region (including the Missouri River near Stanton). Enyeart (1975) has also discussed wildlife habitat relationships in the five year habitat development and maintenance plan for district V, which includes Mercer County, of the North Dakota State Game and Fish Department (NDG&FD). Portions of all the above mentioned documents can be extrapolated to apply to the Glenharold Mine area.

Very little significant aquatic habitat is present on the proposed lease tracts at the Glenharold Mine. Zooplankton and aquatic macro-invertebrates are expected to occur where aquatic habitat is present, although no surveys of these aquatic animals are available for the coal lease tract. The status of these populations is variable and depends on the momentary condition of the aquatic habitat. The zooplankton and macroinvertebrate popluations found on these wetlands are regarded as very important seasonal items in the food chains of the higher animal forms (i.e., fish, waterfowl). The environmental requirements and relationships of many of these invertebrate organisms in lotic habitats is discussed by Bovee (1975). In some instances, these relationships would also apply to the ponds in the Glenharold Mine area. Woodward-Clyde (1975) discuss the occurrence and relative abundance of invertebrate organisms collected during the environmental studies of the ANG project area.

The natural wetlands in the immediate mine vicinity are not expected to maintain fish populations because of their small size and temporary nature. The Institute for Ecological Studies (Seabloom, 1973) reporting on an area in McLean County, indicated that sticklebacks (Eucalia inconstans) and golden shiners (Notemigonus crysoleucas) are widely distributed in North Dakota and commonly inhabit warm, weedy lakes, sloughs and ponds. These species could be present in some of the larger and more permanent ponds in the Glenharold Mine vicinity, although no information is available to verify this. The Missouri and, to a lesser extent, Knife River do support a sizeable fishery (Montgomery, 1975b; Woodward-Clyde, 1975; Bovee, 1975). The NDG&FD stocks Arroda Lake (a recreational lake approximately five miles east-southeast of the Glenharold Mine area) with fingerling rainbow trout (NDG&F, 1976). A listing of fish species which are expected to occur in the Oliver-Mercer planning unit (Montgomery, 1975) appears in Appendix 2.

Since no specific faunal reconnaisance information presently exists for the Glenharold area, status and distribution data for reptiles and amphibians is lacking. Wheeler and Wheeler (1966) have developed a comprehensive synopsis of the amphibians and reptiles of North Dakota. This source provides a species list which may be extrapolated to infer species occurrence in the Glenharold Mine vicinity. Woodward-Clyde (1975) also discuss the relative abundance and occurrence of reptiles and amphibians near Beulah. This information should be applicable to the Glenharold Mine area (see Appendix 2).

No site-specific distribution or population status information exists for the immediate coal lease tract, however, several comprehensive works on the bird-life of North Dakota are pertinent and may be extrapolated for this immediate area. Stewart and Kantrud (1972) have established relative abundance for breeding birds North Dakota by determining population estimates. Stewart (1975) has presented an extensive analysis of the breeding birds of North Dakota (see Appendix 2). Due to the diverse habitat complex at the coal lease site, a rich contingent of bird-life could be expected to occur there. Several significant bird species may be found in the Stanton vicinity. Enyeart (1975) considers waterfowl habitat and population values in this portion of district V of the NDF&GD as low. The Glenharold Mine lies in the central flyway and just west of the immensely productive prairie pothole biotic region, which is well known for its vast waterfowl breeding grounds. Sharp-tailed grouse (Pedioecetes phasianellus) populations and habitat are considered low to medium in value throughout district V of the NDF&GD (Enyeart, 1975). The lease tract contains blocks of native grass and brushlands (sharptail habitat), and could be expected to partially support a sharptail population.

Enyeart (1975) indicates low to medium Hungarian partridge (Perdix perdix) values for populations and habitat throughout the NDF&GD district V (including the Glenharold Mine vicinity). "Huns" could be expected to utilize the coal lease tract in its present state. Pheasant (Phasianus colchicus) populations and habitat values in this district are rated as low to medium (Enyeart, 1975). Most of the lands lying along the Missouri River bottom meet the criteria for prime pheasant habitat. The Missouri River bottom between Bismarck and the Garrison Dam presently supports one of the largest wild turkey populations in North Dakota (Jacobsen, 1963). Due to the close proximity of the Glenharold Mine to the Missouri River bottom, it is feasible that wild turkeys may be found on the mine area. Enyeart (1975) rates population and habitat values for wild turkey in district V as low to medium. These values would probably be higher were it not for continuous habitat attrition and loss. The Glenharold Mine area lies in the migration flyway of the whooping crane (Grus americana), an endangered species (McKenna and Seabloom, 1976). There are no known records of whooping crane use of the Glenharold Mine site and no significant habitat for whooping cranes is present there. The peregrine falcon (Falco peregrinus), an endangered species, historically ranged into North Dakota (Stewart, 1975). There is no known record of these birds on the Glenharold Mine site.

No specific information on distibution and status of mammal populations for the Glenharold Mine site is available. Bailey (1926) developed a comprehensive survey and published account of the fauna of North Dakota. Montgomery (1975b), Enyeart (1975), Woodward-Clyde (1975), and the BLM (1973) have discussed the relationships of the endemic mammals of the Mercer County region. Much of this information can be extrapolated for the Glenharold area. A few mammal species of major economic and recreational importance can be found in the Glenharold vicinity. Adams (1961) discusses the distribution and ecology of the furbearers of North Dakota. Many of these animals can be found in this region. Muskrats (Ondatra zibethica), raccoons (Procyon lotor), mink (Mustela vison), long-tailed weasels (Mustela frenata), striped skunks (Mephitis mephitis), red foxes (Vulpes fulva), coyote (Canis latrans), white-tailed jackrabbits (Lepus townsendi), and eastern cottontails (Sylvilagus floridanus) are relatively common in this portion of North Dakota and could be expected to occur on or near the coal lease tract. Both eastern gray (Sciurus carolinensis) and eastern fox (Sciurus niger) squirrels are also expected to inhabit the Missouri River bottom in the Stanton vicinity. Less common furbearers that may be present on the lease tract include: short-tailed weasel (Mustela erminea), badger (Taxidea taxus), and beaver (Castor canadensis). White-tailed deer (Odocoileus virginianus) are the most prominent game animal in the Glenharold Mine area. The abundance of forage, cover (both vegetative and mechanical), and habitat interspersion on the mine area provides ideal conditions for white-tailed deer. Enyeart (1975) rates white-tailed deer habitat and populations values for district V as ranging from high to low, depending on the quality of the range and extent of overgrazing at any specific site. Mule deer (Odocoileus hemionus) can also be found in the relatively broken "breaks" country adjacent to the Missouri River (including the Glenharold Mine area). Enyeart (1975) rates mule deer habitat and populations values in district V as, generally, low. Enyeart (1975) rates pronghorn populations and habitat as, generally, low for this portion of district V of the North

Dakota Game and Fish Department. Antelope have been known to occur in the general Glenharold Mine area (BLM, 1973). No mammals officially considered as endangered or threatened (i.e., published in the Federal Register) are known to occur in the mine area.

ECOLOGICAL PROCESSES

Ecoclass

Broad natural relationships can be revealed by relating landforms and associated features as Ecological Land Units (ELU's). ELU's are geographic areas which are separated and named according to landform and vegetation (Corliss and Pfister, et. al., 1973). Each ELU has individual elements (landform, vegetation, soils, water, wildlife and human values) which make it different from other ELU's. Furthermore, each ELU has its particular degree of interdependence of the natural elements within the ELU. This relationship is shown in Appendix 2, Page 70.

The cross section in Appendix 2, Page A2-4 illustrates typical landforms which make up the ELU's found in the Stanton vicinity. The landforms present on the proposed lease tracts are (1) Dissected Plateau and (2) Mined area.

These two landforms can be subdivided into two natural and two artificial ELU's which occur on the proposed lease tracts. These ELU's also show relationship between landform and vegetative type:

TABLE 2-4

ECOLOGICAL LAND UNIT
(ELU) NAMES

1.	a.	Dissected Plateau - Prairie Woodland Thicket (DP-PWT)
	b.	Dissected Plateau - Steppe Grassland (DP-SG)
	c.	Dissected Plateau - Agricultural Lands (DP-AG)
2.	d.	Mined Area - Disturbed Site (MA-DS)

The acreage for the subject lease tract ELU's are shown below:

TABLE 2-5

ACREAGE AND PERCENTAGE ESTIMATES
(ELU's on the Glenharold Mine proposed Federal coal lease tracts. T. 144 N., R. 84 W., Stanton, North Dakota).

ELU		Acres 1/	%
DP-PWT	(1a)	105.6	22.0
DP-SG	(1b)	217.0	45.2
DP-AG	(1c)	117.1	24.4
MA-DS	(2d)	40.3	8.4
TOTAL		480.0 acres	100.0 %

1/ Acreage estimates were made with the aid of a dot-grid acetate overlay (Scale = 484 dots/640 acre section).

Appendix 2, Page A2-71 shows ELU's on the proposed Glenharold lease tracts (black and white print of a 1975 color infra-red photo base). ELU boundaries may imply definite breaks in relationships, however, some boundaries between ELU's are diffused, and some ELU's contain portions of other ELU's too small to be mapped individually (see Appendix 2, Photos, pages A2-72 through A2-74 for pictures of the ELU's on the lease tracts).

Unique Ecosystems (Environmentally Sensitive Areas)

A unique community is sometimes defined as " . . . one which is extremely limited in extent or occurrence and/or possesses attributes of special academic interest." Using this definition, the proposed lease tracts do not appear to be "unique," although the physiographic type found at the Glenharold Mine is somewhat limited in occurrence. Both the floral and faunal communities found here are common throughout the physiographic region and do not possess any particular academic significance.

Environmentally sensitive areas have been defined as " . . . ecologically fragile and consequently extremely vulnerable to destruction . . ." (Smithsonian, 1974). Shrub and tree growth in this region is very site-specific and intimately keyed to the microclimate, and therefore, could be considered environmentally sensitive.

Succession - Climax - Limiting Factors

Approximately 32.8% of the proposed lease tracts surface have been disturbed by agricultural cultivation, strip mining, and related facilities, which altered the natural succession (orderly process of community change). The remaining area is rangeland, grazed by domestic livestock. Consequently, the rangeland exists in varying degrees of disclimax. Since the entire range area is accessible to domestic livestock, no vegetative "relict" areas exist on the lease tracts. In this biome (the largest land community unit which is convenient to recognize), the principal environmental limiting factor for vegetative growth is the seasonal availability of moisture for plant growth. Many man-caused land use practices also limit native vegetation and wildlife. The Northern Great Plains Resources Program (1974) considers this overall region to have "good" to "fair" suitability for rehabilitation following surface mining.

Community - Food Relationships

The coal lease tracts are approximately 67% native rangeland, with a relatively high natural diversity (see Appendix 2, Page A2-75). At present, wildlife habitat is not severely limited or encroached upon. Most ecological "niches" are filled with native species. Some of the "niches," however, are filled or replaced by agricultural plantings and species introductions. Plant communities are well mixed. The natural food chain relationships remain well represented at all trophic (food-energy) levels, with the possible exception of large herbivores (plant eating animals) and large carnivores (meat eating animals). Large carnivores remain scarce, and large native herbivores have been replaced by domestic livestock in some cases. Natural nutrient cycles may have been altered through fertilization of croplands for agricultural production.

CULTURAL RESOURCES

The lease application lands are near many archaeologic and historic sites (see Appendix 2 for detailed archaeological-historical summary). The most significant of the known sites in the area is the Knife River Indian Villages National Historic Site, located just north of Stanton, North Dakota. Listed on the National Register of Historic Places, these villages have been added to the National Park System. The National Park Service will develop the villages as a visitor attraction.

The site of Fort Clark, a 19th century fur post, is currently a State Historic Site located 7½ miles southeast of Stanton. The State Historical Society of North Dakota has conducted archaeological investigations to establish the limits of the fort. Analysis of materials recovered in their work is now in progress (Personal Communication, Nick Franke).

The Historical Society has a record of ten more archaeologic and historic sites in the same township as the Glenharold Mine and the lease application lands. Nine of these sites have been classified as having potential for nomination to the National Register. The tenth is thought to be a candidate for a State Historic Site.

Consolidation Coal Company has contracted with the Historical Society for cultural resource inventory of their mining areas. Of the lease application lands considered in this analysis, the NW¼NE¼ and E½E½, Sec. 30, T. 144 N., R. 84 W., have been surveyed. No sites were located on these tracts. The N½N½, Sec. 32 of the same township has been contracted for inventory. The remaining portions of Sec. 30, Sec. 32, and Sec. 20, T. 144 N., R. 84 W., have not yet been inventoried or contracted for inventory (Personal Communication, Nick Franke).

While it is not known if the unsurveyed lease application lands contain significant archaeologic or historic materials, the potential for locating sites here is high considering the intensity of prehistoric and historic activity in the area. During a preliminary examination of Consolidation's Glenharold operations, a BLM archaeologist noted scatters of waste material which are the result of the manufacture of stone implements in Sec. 30 and Sec. 32 of the federal coal lands. The stone waste material indicates prehistoric human activity areas which need further investigation.

AESTHETICS

The scenic quality of the proposed coal lease tracts and the adjacent area was rated according to procedures in the BLM Visual Resource Management Manual (See Appendix 2). This procedure involves assigning numerical values to various factors affecting scenic quality. The area received a score of 9 out of a possible 24 (see Appendix 2, Figure A2-15).

The area lies within the "River Breaks" portion of the "Upper Missouri Basin Broken Lands" described by the Northern Great Plains Resources Program (1974). The "Knife River Breaks" are not as pronounced as other breaks areas within the region. The river bluffs are generally lower and the wooded draws are shallower. Vegetation includes trees, shrubs, and grasses. Deciduous trees and shrubs occur along the river and in the tributary draws. The uplands are rolling grassy plains or farmland. Land patterns include coal strip mines, cultivated fields, roads, telephone lines and power transmission systems.

The overall characteristic of the landscape is a vast, open panorama with little sense of restriction. The major scenic value of the area derives from variety provided to the surrounding rolling plains by the wooded river valleys.

Mining operations adjacent to the proposed coal lease have caused some changes in the aesthetics of the area. Unreclaimed spoil piles have created a strong artificial form element. Natural vegetative and agricultural patterns are disrupted. Noise and dust levels are increased by heavy equipment and trucks. Noise levels are not high enough to be considered particularly offensive by the average person.

RECREATION

The proposed coal lease tracts do not contain any developed recreation sites. The major recreation potential for the lands involved is hunting upland game and deer. The ongoing mining operations on adjacent land have, for all practical purposes, eliminated this use during the life of the mine.

The developments associated with Lake Sakakawea provide the major public outdoor recreation opportunities near the proposed coal lease. A list of outdoor recreation areas and available facilities is included in Appendix 2, Table A2-12.

No attempt was made to determine the availability of indoor recreation facilities such as bowling alleys, theaters, etc. Sports and game facilities (i.e., baseball fields, golf courses, etc.) are included in Appendix 2, Table A2-12.

The 1975 North Dakota State Comprehensive Outdoor Recreation Plan (SCORP) included a determination of recreation facility needs. This study (based on 1973 data) indicates that use demand exceeds the available supply of recreation facilities for nearly every activity. ~~See Appendix 2, Table A2-12, for a summary of recreation needs.~~

SOCIO-ECONOMIC CONDITIONS

Population

Mercer County lost 9.3% of its population through the 1960-70 period. The population total for 1960 was 6,805; in 1970 it was 6,175 with 33.6% of residents classified as rural farm and 66.4% as rural non-farm. No town in the county met the criterion of 2,500 residents required to be classified as an urban area. By 1974, the county population had increased to 6,400 citizens (BLM, 1975).

While Mercer County experienced a population decline between 1960-70, the city of Stanton's population rose 26.4% over the same period, from 409 to 517 persons. This increase was due to lignite mining operations and construction of nearby power plants (Luken, 1974).

Without further energy development, the population estimate for Mercer County in 1980 is 6,314 (BLM, 1975). Contrasted with this stable population projection is an estimate of 13,348 persons for the same period, taking into account further lignite mining and the construction of more power facilities (Luken, 1974).

Industry, Income and Employment

In 1969, Mercer County had 623 farms with total sales over $2,500 per year. The average size of these farms was 899.3 acres, totaling 343,052 acres of cropland in the county. This acreage produced crops selling for $3,245,000 in 1969. Livestock and livestock products sales were $5,235,000 for the same year. Fifty thousand head of cattle were produced in the county (BLM, 1975).

The value of all minerals produced in Mercer County in 1968 was $5,671,000. Most of this revenue resulted from the production of 3,318,947 tons of lignite. The county is one of North Dakota's principal lignite producers (Ibid.).

In 1967, Mercer County had 19 wholesale establishments with a trade volume of $6,055,000 and 91 retail establishments whose volume totaled $9,127,000. The county's 52 service firms produced a sales volume of $748,000 in the same year. There were six manufacturing establishments (Ibid.).

The median family income of Mercer County in 1970 was $6,714; $1,124 less than the North Dakota state figure of $7,838. Per capita income was $2,675. While 17.7% of the county's families were below the poverty level, 7.1% of the families earned $15,000 or more annually. The number of familes below the poverty level exceeded both state (12.4%) and national (10.7%) levels in 1970 (Ibid.).

The total labor and proprietor's earnings in 1972 for the county was $17,317,000. Contributions of various economic sectors to the total earnings are listed below:

Economic Sector	Earnings	% of Total Earnings
Farm	$4,740,000	27.4
Mining	2,509,000	14.5
Manufacturing	208,000	1.2
Contract Construction	1,799,000	10.4
Government	1,959,000	11.3
Trans., Comm., Public Utilities	2,260,000	13.1
Wholesale/Retail Trade	1,835,000	10.6
Finance, Insurance, Real Estate	Undisclosed	
Services	1,653,000	9.6

The term "earnings" means the sum of salaries and wages, other labor income, and proprietor's incomes. The mining industry was the second largest contributor to earnings generated in Mercer County in 1972.

Employment data by economic sector is also available for 1972 (BLM, 1975).

Sector	Number Employed	% of Total Employment
Farm	823	35.8
Mining	164	7.1
Manufacturing	38	1.7
Construction	149	6.5
Government	374	16.2
Trans., Comm., Public Utilities	201	8.7
Wholesale/Retail Trade	272*	11.8
Finance, Insurance, Real Estate	29	1.3
Services	252	10.9

* 1974 employment

Since 1972, the county's employment picture has been influenced by the construction and operation of a second generating plant by Basin Electric Power Cooperative and increased production at the Glenharold Mine.

Public Finance and Tax Base

The 1973 taxable property valuation for Mercer County was $6,314,000. Most of the valuation derives from real estate (89% statewide) while personal property accounted for less than one percent of the total.

Taxes levied on general property and special taxes by the state and localities totaled $918,300. These taxes were levied according to purposes shown below (Woodward-Envicon, Inc., 1974):

Purpose	Property Taxes Levied
State	6,500
County	249,400
Township	17,950*
School	540,850
Special District and Misc.	10,500
City	93,100

*Estimate

North Dakota depends heavily on a four percent sales tax for revenue. In 1974, Mercer County generated $734,200 in taxes from $34,576,500 in total sales. About 53% of the total sales were taxable under the sales and use tax statutes of the state (BLM, 1975).

Infrastructure

Mercer County had 2,161 residential buildings in 1970 comprised of 1,871 one-unit structures, 156 multiple-unit structures, and 134 mobile homes (Lukin, 1974). Ninty-two housing units were classified as vacant, seasonal or migratory units. The median number of persons per housing unit for all types of occupied structures was 2.7 (BLM, 1975). The city of Stanton's 1970 housing inventory included 119 single-unit structures, 15 multiple-unit structures, and 24 mobile homes (Luken, 1974). Energy development since 1970 have probably changed the housing situation in both the county and Stanton.

The number of students enrolled during 1972-73 in Mercer County schools was 1,539; elementary enrollment totaled 1,037 and secondary enrollment was 502 (BLM, 1975). Enrollment of Stanton's single combined school facility totaled 176 elementary students and 75 secondary students in 1973. At that time, the school reportedly had a capacity for an additional 72 elementary and 26 secondary pupils (Luken, 1974). The county employed 53 elementary teachers, 36 secondary teachers, and 54 non-professional school personnel in 1974 (BLM, 1975).

Mercer County medical care facilities in 1973 are listed below (BLM, 1975):

Facilities	Number	Location	Capacity
Hospitals	1	Hazen	39 beds
Clinic	1	Hazen	1 physician
Nursing Home	1	Beulah	40 beds
Retirement Home	3	Beulah	30 beds
		Hazen	28 beds

Medical Manpower	Number
Dentists	0
Licensed Practical Nurses	11
Pharmacists	3
Physicians	3
Registered Nurses	12
Veterinarians	2

There were six law enforcement personnel working for Mercer County in 1974. The sheriff and one deputy were stationed in Stanton and a deputy each in Hazen and Beulah. Pick City and Stanton shared one man while another deputy split his duties between Golden Valley and Zap (Luken, 1974). The Federal Bureau of Investigation's Uniform Crime

Reports showed Mercer County unlawful behavior at 178 incidents per 100,000 persons; well below the statewide rate of 2,078 per 100,000 (BLM, 1975).

A joint city-rural fire district served the Stanton area in 1974. Two pumper trucks with capacities of 500 and 205 gallons per minute were operated by a 33-man volunteer force (Luken, 1974).

Stanton's water supply derives from private wells. No public water system was planned as of 1974. Sewage is treated in a 3.13-acre primary lagoon and a 2.05-acre secondary lagoon. The treatment system has a daily flow capacity of 33,000 gallons. The 1974 average flow was 26,000 gallons per day. Solid waste disposal is contracted on a county-wide basis (Luken, 1975).

Mercer County has 90 miles of state highway and 17 miles of county road which is hard-surfaced. There are about 300 miles of graveled county road (Ibid.).

Public Attitudes Toward Energy Development

Several studies have been conducted in coal areas to determine the attitudes of local residents toward energy development. The 1974 study by Lemmerman was designed to test the attitudes of people in two communities which had experienced coal development and decline in Northwest North Dakota. The results of this opinion survey are summarized below:

> 74% of the people think there should be more coal development in North Dakota.
>
> 83% of the people think it is possible to have both industrial growth and a prosperous agricultural community in North Dakota.

79% of the people think the underground (ground) water in the area has not been affected by coal development.

76% of the people would like to see more coal development in the Burke-Divide County area.

87% of the people think coal development has been generally good for the Columbus/Noonan area.

While the attitudes expressed in this survey are generally favorable toward coal development, many persons who participated in the study felt that strong state controls over the mining is necessary.

Another public attitude study was conducted in 1974 covering Mercer and 27 other North Dakota Counties (Bickel and Markell, 1975). Five hundred seventy-two high school seniors were asked their opinions of various aspects of coal development. The results of this study corresponded well with the Lemmerman report. While 80% of the students had lived in North Dakota 16 or more years, their attitudes were generally favorable toward coal development.

The results of these studies indicate favorable attitudes toward energy development by a majority of the people surveyed, however, Lemmerman (1974) cautions:

> It would be inaccurate to imply that there is total consensus among the residents of the area concerning coal development. Although interviewing and surveying indicated a remarkedly high positive consensus toward coal development, minority viewpoints were evident. Not only are anti-coal attitudes in existence, the people who express these viewpoints are some of the most verbal in the two communities. Similarly, of the people who took the time to write lengthy comments on the attitudes survey, most were anti-coal development . . . .

CHAPTER 3

ENVIRONMENTAL IMPACTS

This chapter discusses the impacts which would be expected if the proposed action were put into effect. It is assumed that the required mitigating features discussed in Chapter 1 would be incorporated. Chapter 4 contains additional mitigating measures developed as a result of this analysis. Appendix 3 contains the specific impact ratings for all those impacts discussed in this chapter. Environmental analysis worksheets and rating criteria appear in Appendix 3.

CLIMATE

Removal and stockpiling of the topsoil would destroy all vegetative cover. Vegetation normally has a cooling effect by shading the surface. Surface air, with normal changes in temperature, follows the topography. The air temperature would increase and alternatives in the landform would change the direction and flow of air to follow the new topography created by the overburden piles. Only the microclimate would be affected. General air movement patterns would not be impacted.

It is not expected that reclamation would duplicate the exact conditions prior to mining, but a rolling land form would be replaced. This new topography combined with the revegetation operation would result in a beneficial impact on the climate. The vegetation would act as a buffer against extremes of temperature and would facilitate the establishment of successionally more advanced vegetative types suitable to the area. For some trees and shrubs, this shade modification of temperature may be a critical factor in regeneration. The general air movement and air temperatures throughout the area would not be affected by the action.

LAND USE

The lease consists of three separate tracts. One 80 acre tract is located in the W$\frac{1}{2}$SE$\frac{1}{4}$, Sec. 20, T. 144 N., R. 84 W., 5th P.M. The south half is abandoned cropland and the north half is rolling hills currently used as grazing land. There is a small stock watering pond located near the NE corner of the tract. Mining is taking place directly to the south and west of this tract.

A second tract, containing 240 acres is located in E$\frac{1}{2}$E$\frac{1}{2}$, NW$\frac{1}{4}$NE$\frac{1}{4}$, SW$\frac{1}{4}$SE$\frac{1}{4}$, Sec. 30, T. 144 N., R. 84 W., 5th P.M. The entire tract consists of rough rolling hills with numerous woodland draws. A small stock watering pond is located in the southwestern corner. Its primary use is wildlife habitat and livestock grazing.

The third tract contains 160 acres and is located in N$\frac{1}{2}$N$\frac{1}{2}$, Sec. 30, T. 144 N., R. 84 W., 5th P.M. It is a combination of cropland and native range. The level areas are being dryland farmed for small grain. The gentler slopes are cut for native hay, with the remainder being used for livestock grazing. Mining operations presently touch the south edge of the tract.

The surrounding land use pattern is dryland farming, livestock forage, wildlife habitat, and surface mining. The area has a diverse vegetative cover and provides good wildlife habitat.

The tracts are surrounded by private land. Access is restricted and not open to those not having landowner permission.

Glenharold Mine

Aerial Photo 8-7-75

Acreage

T. 144 N., R. 84 W., 5th P.M.

Sec. 32:	$N\frac{1}{2}N\frac{1}{2}$		160 ac.
		Cropland	71 ac.
		Native Range	89 ac.
		Total	160 ac.
Sec. 30:	$E\frac{1}{2}E\frac{1}{2}$, $NW\frac{1}{4}NE\frac{1}{4}$, $SW\frac{1}{4}SE\frac{1}{4}$		240 ac.
		Native Range	240 ac.
		Total	240 ac.
Sec. 20:	$W\frac{1}{2}SE\frac{1}{4}$		80 ac.
		Cropland	40 ac.
		Native Range	40 ac.
		Total	80 ac.

AIR QUALITY

The removal and stockpiling of the topsoil and the transportation, delivery, and crushing of the coal would result in an increase in particulate matter. Removal and spoil piling of the overburden along with blasting, excavation, and loading of the coal would cause an increase in fugitive dust. This would be insignificant in magnitude.

During some periods of the year, high winds could cause the ambient air standards to be exceeded at the mine. They must meet State air quality standards in order to continue operations.

The entire operation would result in an increase in exhaust emissions. Heavy equipment powered by gas or diesel engines, would cause local gas emission increases. This would result in a negative impact, but the magnitude is so low that it was deemed insignificant.

Particulate matter would also increase during reclamation. The regrading and top-soiling operations would create most of the fugitive dust because of disturbance by heavy equipment. These are on-going processes that would continue for the life of the mine. The impact from seeding the reclaimed land is expected to be insignificant in terms of additional particulate matter.

GEOLOGY

The primary impacts which mining would have on the geologic component of the environment would occur during the overburden and coal removal stages of operation. The integrity of the sedimentary strata comprising the overburden and that of the coal bed would be destroyed during these operations. The paleontological values in these geologic materials, which are negligible, would likewise be destroyed.

TOPOGRAPHY

The major impact to the topographic component of the environment would occur during the overburden removal stage of the mining operation. Overburden removal, via dragline to depths often exceeding 150 feet, would radically modify the natural topography.

WATER

The mining operation has already altered the hydrologic characteristics of the area. Therefore, the mining of Federal coal would have little additional impact on the area's water resources.

Hydrologic Cycle

The hydrologic cycle is the constant circulation of water from the atmosphere to the land and the subsurface then back to the atmosphere again.

Removal of the topsoil would affect changes in runoff, interception, infiltration, percolation, and evapotranspiration. The stockpiled topsoil may experience an increase in porosity and permeability due to the break up and mixing of the material during removal.

During removal of the overburden and the spoil piling, the hydrologic cycle would be further disturbed. The material directly over the lignite and the lignite itself make up the ground water aquifer. Overburden removal would destroy part of the existing aquifer.

Blasting and excavating the coal would also have adverse impacts on the aquifers in the mine area. By removing the coal, these aquifers would be eliminated. Because of this and the fact that underlaying the lignite are layers of clay, it is theorized that the ground water could flow laterally, and may increase ground water discharges in low laying areas down dip from the mine.

Reclamation would have positive affects on the disturbed area's hydrologic cycle. Regrading would restore the area's topography and thus influence the hydroloic characteristics. This process should promote increased porosity and permeability until compaction or subsidence occurs. Locally, ground water accumulation may increase.

By topsoiling, the hydrologic cycle would be further re-established. The placement of topsoil on the regraded spoils would increase infiltration, promote interception and establish a runoff cycle. The mixed topsoil would increase the water holding capacity and facilitate revegetation. Revegetation, over a period of time, would help re-establish the hydrologic cycle.

Sediment Load

Sediment load is the solid material, both organic and mineral, that is suspended in water.

Runoff and ground water inflow from the mine area collects in the mine pits. This water is pumped intermittently into sediment ponds and allowed to evaporate, thus presenting the majority of sediment from leaving the mine site.

With the removal of topsoil, the sediment from both the stockpiled topsoil and exposed overburden areas would increase. This amount would vary with the time of the year and the length of time the materials are exposed prior to their stabilizing.

Overburden removal and coal excavation could add to the sediment load. This could be the result of seasonal runoff from the spoils and ground water inflow into the pit coming in contact with the overburden and broken lignite during its removal.

Replacing and regrading the spoil piles would have a benefical affect on the disturbed area's sediment load. Removal of the stockpiled topsoil and their steep slopes would reduce the probability of erosion and increased sediment load. Regrading would have some negative affects on the area's sediment load during the early phases of the operation primarily as a result of further disturbance. After regrading, a layer of topsoil is placed on the regraded spoil. The interim between topsoil replacement and revegetation is the period during which the topsoil is most susceptible to erosion. Revegetation would reduce the amount of material that may be removed by erosion.

Water Quality

For the purpose of this report, water quality will encompass dissolved solids, chemicals, heavy metals, and toxic substances, nutrients, solid debris, coliform contamination, pH, dissolved oxygen, and temperature. The amount of dissolved solids is an indicator of water suitability; the suitability of water decreases with an increase in dissolved solids. Chemicals, heavy metals, and toxic substances are relatively unknown in the local area. Solid debris and coliform contamination are of little concern in the area. Acid balance (pH) should remain much the same throughout the mining operation with the possible exception of the revegetation process. The ability of water to hold oxygen decreases with an increase in temperature and dissolved solids. In the area, this is not a major concern because of aquatic habitat that could be affected. Temperature can also alter the water quality.

An increase could contribute to undesirable conditions such as increased oxygen demands and by promoting the growth of taste and odor producing organisms.

The water quality of the area would vary depending on the time of the year and the volume of water. Chemical concentration would increase with decreased volume or an increase in chemicals encountered. Chemical concentrations can also be decreased through dilution with an increase in water volume.

Excess water in the mine is pumped continuous into Bowers Coulee directly from the pits and is untreated.

The affects of topsoil removal and stockpiling are relatively insignificant. With its removal, the overburden may be subject to increased infiltration and percolation of solution. This should only be for a short time. Topsoil stockpiles, through runoff and erosion, could also cause water quality to be altered for a short time.

Overburden removal may alter the chemical quality of water in the mine area because of the mixing and inverting process. The mixing and overturning may place undesirable material in contact with ground water. This material could be natural occurring elements or waste from the mine. The contact could cause chemicals to go into solution and possibly contaminate a ground water source. This possible contamination coupled with potential increased discharges down dip from the mine could alter the surface water quality at the discharge location.

Excavation of the lignite could alter the chemical quality, but the extent is unknown.

Reclamation activities would affect the water quality of the area. The extent is not known, it is assumed to be slight. This would depend on the material deposited in the overburden and additives applied to the topsoil. Usually, the spoils would be mixed and inverted which could place undesirable material in contact with ground water.

Topsoil would be placed over the regraded overburden and may be treated to facilitate revegetation. If this treatment includes the application of herbicides and/or pesticides, then the quality of water could be affected. This would depend on the amount applied. Nutrients being added would also alter the quality. Generally, as soil nutrients are applied, pH values and chemical compounds can change.

SOILS

Topsoil removal and stockpiling would have a significant affect on soil depth as in some areas 5 feet of soil material would be removed and stockpiled and in others, where soils are shallower, less soil would be available for respreading. The result would probably be a more uniform depth of topsoil and subsoil than exists in the present state. In the Glenharold mine area, the Cabba and Ringling soils, which have an effective rooting depth of 10 to 20 inches, make up about 60% of the area over federal coal. Some of the Cabba and Ringling soils also occur on steep slopes and removal of soil materials will be difficult. These impacts will apply to the mine area in general and to the area over federal coal.

Operations to remove and stockpile the soil would result in complete destruction of the soils material structure. It will take many years for soil structure to develop again. Soil nutrients would be impacted by the mixing of organic matter and by the disruption and loss of soil micro and macro organism, e.g., the soils natural nutrient cycle would be completely disrupted.

Two potential natural soil pollutants are excess adsorbed sodium and excess calcium carbonate. Excess sodium occurs in the Regent-Rhoades soil complex in the Glenharold mine area, but only in a small percentage of the area over federal coal. The impacts from the topsoil removal operation could be positive if these natural pollutants are identified and buried with the overburden. Calcareous materials are less of a problem, but if large amounts are placed on the surface, fertility problems could result. However, as the soils are to be removed in two separate lifts, this problem could be largely avoided by controlling the depth of each lift.

In the short run, erosion of the soil stockpiles or respread soils could be a problem until the piles are vegetated.

Regrading the spoil would have no direct affect on eventual soil depth, structure, or nutrients. It would, however, have a large direct and benefical effect on erosion from the spoil piles and on the topsoil that is spread over them. This action should greatly decrease potential erosion simply by reducing the slopes of the spoil pile.

Of all the activities in the mining operations, topsoiling would have the greatest impact on soil depth. The amount of topsoil actually returned to the leveled spoil piles would depend directly on the amount removed and stockpiled during the mining operations. Where available, up to five feet of soil in two lifts would be removed and either returned directly to the regraded spoils or stockpiled. In this area, 10 to 60 inches of soil and subsoil are generally available. Respreading the soil materials would probably have the effect of making the soil depth much more uniform over the entire area by "averaging" the deep and shallow soils. Removing, stockpiling or immediately respreading the soil material would cause unavoidable mixing of the organic matter rich surface with the subsoil. This adverse action would be partly alleviated by removing the topsoil and subsoil in two lifts.

The operations necessary to remove, stockpile and respread the soil materials would destroy the soils natural structure, thus decreasing water and air infiltration and root penetration.

Soil nutrients would be primarily affected by the mixing of the soil materials during handling operations and by disruption of the nutrient cycle. The majority of the soils organic matter is contained in the upper few inches of soil and would be mixed with whatever is removed during the first lift, e.g., parts of the subsoils would be mixed with topsoil.

Initially, soil erosion would be higher than normal because it would be bare and more susceptible to increased water and wind erosion.

Seeding would have an indirect, but beneficial affect on soil depth as roots, soil micro-organisms and macro-organisms increase to their natural levels. Soil structure would be directly affected by the seeding operations. It is not known exactly what causes structure to form in soil, but it is known that organic matter (plants, roots, micro and macro organisms) has a highly beneficial effect. Seeding would directly affect soil nutrients in two ways: it would add organic matter to the soil as the plants die, decay and are incorporated; and it is assumed that fertilizer would be added during seeding, thus enhancing the soil nutrients.

Seeding would produce a plant cover, increase water infiltration and decrease soil susceptibility to erosion, thus it would have a impact on the mine area in general and the area over Federal coal.

VEGETATION

Three small stock ponds were the only aquatic habitat identified on the proposed lease tracts. Due to the limited area affected, only a minor impact would occur during the mining operation. Once the topsoil is removed, the substrata for support of aquatic vascular plants would be gone, and with it, the aquatic plants. Mining activities adjacent to wetlands may cause dust settlement on aquatic plants, thus adding to the impact on vegetation. Excessive quantities of dust (becoming sediment) accumulating on aquatic vegetation could interfere with normal physiological processes. At any specific mined site, there would be a complete loss of these plants. The impacts of mining on phytoplankton would closely parallel those for aquatic vascular plants. Most floating aquatic plants require a relatively stable, permanent or semi-permanent pool as habitat. Since little aquatic habitat of this nature occurs on the proposed lease tracts, no impact on this environmental sub-component is expected.

The topsoil removal and stockpile operation would have more effect on lichens and mosses than do other discrete mining operations. When the soil is removed, lichens and mosses and their habitat are destroyed. Changing the overall physiographic aspect of the land in the overburden removal operation, would cause a further slight impact lichens and mosses.

The removal of topsoil would destroy the essential supporting substrata for grasses and forbs. Mining activites may cause dust settlement on down wind terrestrial plants and thus add to the impact on them. Excessive dust on plants may interfere with their normal physiological processes. Overburden removal would destroy topographic exposures, thereby, affecting the micro-climate (surface temperatures, moisture accumulation, etc.) with a detrimental impact on vegetation. The impact of overburden removal would not be as severe as that of topsoil removal and thus was considered of lesser importance.

During the mining operations, shrubs would be impacted in the same manner as grasses and forbs, although the overburden removal could be expected to affect shrubs to a greater extent than grasses and forbs.

Broadleaf trees would be destroyed in the topsoil removal operation on any site where they are found within the coal "take-line". Overburden removal would affect the drainage pattern and therefore be an additional impact on broadleaf trees.

Reclamation would represent a beneficial impact on aquatic vascular plants if wetland basins were created. If wetland basins were created, the topsoiling operation would provide a fertile substrata for aquatic plants, and should accelerate the revegetation process. Reseeding of aquatic plants would be beneficial if emphasized in the reclamation process.

The effect of reclamation on lichens and mosses is largely unknown. Lichens and mosses have not been considered for reclamation since they are not particularly useful as forage for livestock and wildlife of this region. They may naturally reinvade a reclaimed area, but their premining status would not likely be attained.

The regrading operation replaces a topography favorable for range plant growth, therefore, benefiting grasses and forbs. Topsoiling and revegetation would be highly beneficial. Topsoiling would provide an immediate plant growth medium, and seeding would greatly accelerate the revegetation process. These impacts should be realized immediately (within one growing season) after initiation. The emphasis on reclamation in this area appears to be toward introduced grass and forb species, as a consequence the pre-mining mixture of native grass and forb species is not apt to be restored.

Most of the shrub complex occurs on steep slopes with coarse soils. This soil-topography complex is critical to shrubs is not apt to be duplicated when the spoil piles are regraded. The replaced topsoil generally will be finer textured than the typical coarse soils of the steep slopes and may be a better growth medium (especially for plants other than shrubs). If shrubs are planted and cared for until they become established, the impact will be beneficial. However, the pre-mining shrub complex probably never would be completely duplicated.

Since the reclamation emphasis is not generally aimed at broadleaf trees, reclamation would not benefit this type of vegetation.

ANIMALS

The removal of topsoil removes the opportunity for significant aquatic habitat, and the animals that occupy it (i.e., muskrats, mink, raccoons, etc.). Removal of the overburden would further this impact by destroying any wetland basin that may have existed. Since little aquatic habitat exists on the subject coal tracts, these impacts would be minor. The occurrence of fish (i.e., minnows, sticklebacks) in the ponds on the proposed coal lease is unknown, therefore, impacts on these animals would be undetermined.

Topsoil removal would also destroy terrestrial habitat. This would have a significant detrimental effect on terrestrial animals (deer, cattle, songbirds, grouse, bull snakes, etc.) because all cover and food are removed. The effect would continue for the life of the mine on successive areas. Overburden removal affects the relief of the land and thereby would impact animals by changing their macro-environment. This impact would be considered additive, but minor, when compared to topsoil removal. Blasting and excavation would not impact terrestrial animals permanently. After initial alarm responses, wildlife would not be expected to pay much attention to the mining disturbance. Collisions between transient wildlife and coal haul trucks would be an adverse impact. Because this is a relatively infrequent event, this impact must be considered unimportant.

Man, as an animal, would be detrimentally impacted by topsoil removal because a food source (cropland or rangeland) would be lost.

This impact is relatively slight, however, because of the small area involved. The safety hazard to man during all the mining operations would be an important consideration for the life of the mine.

Reclamation would have a beneficial impact on aquatic animals if wetland complexes were produced. Reclamation emphasis has been away from wetlands, therefore, the impact on aquatic animals would be unimportant. Wetland basins could be created in the regrading operation; an aquatic vegetation substrate could be replaced with the topsoil; and revegetation with aquatic plants could assure the existence of aquatic habitat. Any aquatic habitat created, however, would differ from the pre-mining condition, and would take many years to establish, stablize and become diverse.

Regrading of the spoils would create a favorable topography for topsoil replacement and vegetative growth, and therefore would be important to all terrestrial animals. Topsoil replacement would be even more beneficial because it provides a plant growth substratum for revegetation which would include herbivore food plants. Soil invertebrates would be highly benefited by topsoiling. The revegetation operation provides the habitat cover and food complex required by terrestrial animals.

Revegetation would also restore the surface for man's activities and, from that standpoint, has a beneficial impact.

ECOLOGICAL PROCESSES

During mining topsoil removal would destroy the vegetation and cause plant and animal succession and community relationships to regress. However, succession is a dynamic process and new vegetative establishment soon starts. Therefore, the long term impact would be of lesser importance. Overburden removal would change the land relief and the potential vegetative climax. The impacts on food and community relationships would parallel those of succession.

During reclamation, regrading would create a topography favorable for plant establishment, although the resultant vegetation would depend largely on the final relief of the land. Topsoiling would further enhance vegetation re-establishment. The revegetation process would establish a plant successional stage and provides a basis for animal habitat. For these reasons, revegetation would be considered beneficial in both the short and long run. The impact rationale for food and community relationships in the reclamation stage would parallel those for succession.

The exact conditions which created the present ELU's would never be duplicated after mining (see Appendix 3, Page A3-6). The new ELU's created in reclamation would eventually balance, functionally, with adjacent unmined ELU's. The overall long term impacts of this new balance are unknown.

CULTURAL RESOURCES

The primary impact of strip mining on cultural resources is the destruction of archaeologic and historic sites. During the removal of topsoil and overburden operations, most cultural values are lost. The objects or features themselves are not the only loss. The context in which these resources were originally deposited is essential to reconstructing the story behind the objects. Mining causes the loss of cultural resources and their context which affects the information obtainable.

A secondary impact is related to increased population in the mining area. More people would result in an increased number of relic hunters and vandals. The damage these people may do is difficult to assess.

The magnitude of the mining impact can be determined only after an intensive cultural resource survey has been conducted. Any sites located in this reconnaissance must then be evaluated according to the process described in Chapter 4.

AESTHETICS

The analysis of impacts on visual resources are based on procedures contained in Bureau Manual 6320. These procedures involve measuring the contrast on the four landscape elements (line, form, color, and texture) created by the proposed action.

Texture is the strongest landscape element in the rating area. It is expressed by the erosional pattern and vegetative types. Form, line, and color are all present in nearly equal amounts. The topography (form) is basically rolling hills. The unreclaimed spoil piles add an artificial form. Color is generally expressed through seasonal vegetative changes. Line is expressed by structures (roads, fences, powerlines) and field boundaries.

The ease of detecting contrast varies according to the following scale: 4 (form); 3 (line); 2 (color); and 1 (texture). Assigning values to indicated degree of contrast (3 for strong, 2 for moderate, and 1 for weak) permits the establishment of a direct multiplier for indicating the strength of the contrast.

The following tables are the contrast ratings for the period of active mining (Table 3-1) and following reclamation (Table 3-2). A score for each feature of 1-10 indicates the contrast can be seen, but does not attract attention (low impact); 11-20 attracts attention (moderate impact); 21-30 demands attention (high impact).

Table 3-1

CONTRAST RATING DURING MINING

	Element		Contrast		Score	Maximum Possible Score
Land Surface Features	Form-4	x	Weak-1	=	4	12
	Line-3	x	Weak-1	=	3	9
	Color-2	x	None-0	=	0	6
	Texture-1	x	Moderate-2	=	2	3
		Subtotal			9	30
Vegetation Features	Form-4	x	None-0	=	0	12
	Line-3	x	Weak-1	=	3	9
	Color-2	x	Moderate 2	=	4	6
	Texture-1	x	Weak-1	=	1	3
		Subtotal			8	30
Structure Features	Form-4	x	None-0	=	0	12
	Line-3	x	Weak-1	=	3	9
	Color-2	x	None-0	=	0	6
	Texture-1	x	None-0	=	0	3
		Subtotal			3	30
		TOTAL			21	90

The summary rating of 21 indicates a low impact. Changes in form, line, and texture of land surface features resulting from mining accounts for 9 points. Disturbance of existing vegetation features would affect line, color, and texture. The additional roads would cause a weak contrast in the line element of structure features.

Table 3-2

CONTRAST RATING AFTER RECLAMATION

	Element		Contrast		Score	Maximum Possible Score
Land Surface Features	Form-4	x	Weak-1	=	4	12
	Line-3	x	None-0	=	0	9
	Color-2	x	None-0	=	0	6
	Texture-1	x	Weak-1	=	1	3
			Subtotal		5	30
Vegetation Features	Form-4	x	None-0	=	0	12
	Line-3	x	Weak-1	=	3	9
	Color-2	x	Weak-1	=	2	6
	Texture-1	x	None-0	=	0	3
			Subtotal		5	30
Structure Features	Form-4	x	None-0	=	0	12
	Line-3	x	Weak-3	=	3	9
	Color-2	x	None-0	=	0	6
	Texture-1	x	None-0	=	0	3
			Subtotal		3	30
			TOTAL		13	90

The summary rating of 13 points indicates a very low visual impact after successful reclamation. The form and texture of land surface features will be slightly reduced. Line and color elements of vegetation features would be slightly changed. Some roads would probably remain after mining which would affect the line element of structure features.

RECREATION

The direct impacts on recreation associated with the proposed action would be low. The area involved (480 acres) would be lost to recreation use (primarily hunting opportunities) during the mining and reclamation period. On-going adjacent mining activities have already affected the proposed lease area.

Off site, or indirect, impacts on recreation would be negligible. No increase in employment is anticipated, therefore, no new demands would be created.

SOCIO-ECONOMIC CONDITIONS

Energy developments have impacted the economic structure of Mercer County and the Stanton area since 1965 when the Glenharold mine became operational. Therefore, the socio-economic conditions described in Chapter Two reflect mining impacts. Economic developments not expressed in the Description of the Environment include recently constructed facilities like the second generator at Basin Electric's Leland Olds plant and subsequent increases in Consolidation's coal production.

In 1974, 78 workers were employed at the Glenharold mine. The work force doubled by April, 1976, with 115 union wage earners and 41 salaried personnel (Personal Communication, Consolidation Coal). Applying a 2.50 employment multiplier (Luken, 1974), 195 jobs may be created in the community by doubling the original 78 positions in mining, an export base industry. The 117 additional jobs created should be in service employment for producers of goods and services for firms and individuals within the area.

Studies of the 1974 coal mine work force in North Dakota indicate that a majority of employees had 12 years or less formal education; were quite satisfied with their jobs; and more than 80% of them were from North Dakota. However, it is cautioned that existing work force characteristics may not be maintained if the rate of coal development increases (Leholm, 1975).

Employment increases cause population growth which affects revenues available to state and local governments. Increased population also puts new demands on public facilities supported by tax revenues. Studies in some coal development areas indicated that in the first years of construction and operation of new facilities the local communities are not able to keep up with demands placed on their tax bases (Leistristz, Leholm, and Hertsgaard, 1975).

The approval of the lease application would not significantly affect the already modified socio-economic structure of the area. An additional two years of mining at the present Glenharold coal extraction rate would result.

If the mining of federal coal on the subject lands is not approved, it is likely that the resource will never be recovered. The cost of extracting this coal after contiguous areas have been mined and reclaimed may be prohibitive.

The success of reclamation efforts may determine the usefulness of the mined land for future economic activities such as farming or grazing. The impacts, whether favorable or adverse, may be significant to the economic well being of some people in the mining area.

LAND USE

Suitability

Overburden at Glenharold is shallow and consolidated. It would be easily removed and would not slough. This combined with the rolling topography and other soil characteristics make this area suitable for mining from an engineering standpoint.

The excavation and loading of the coal would be easily accomplished. The coal seams are soft and would be easily fractured.

Transportation, delivery, and crushing would be easily accomplished. All needed facilities are in operation and in good repair.

The mining of federal coal would have the same degree of suitability as mining in general.

Reclamation would be suitable to adjoining land uses, because the land would be reclaimed to the prior use, or to the land owner's desired use.

Regrading the spoils would return the land to its original contour. This, to a large degree, determines the amount of erosion, ease of topsoiling, and revegetation success.

Compatability

The land in this area has two demands placed on it, agriculture and mining. The resources and services for both are readily available.

Leasing the Federal coal would be compatable with mining, which is an adjacent use. The minerals and surface surrounding the federal tracts have previously been leased. The surface overlying the Federal coal has also been leased for mining. The tracts are located in an existing operational mine and in a logical mining sequence.

Mining these tracts would eliminate them from agricultural use until reclaimed, however.

Reclamation would be compatable with adjacent agricultural lands uses because it would return the land to its approximate contour and productivity prior to mining.

CHAPTER 4

MITIGATING OR ENHANCING MEASURES

APPLICANT'S (OR BLM'S) COMMITMENTS

If the project proceeds as proposed, all existing Federal and State laws and regulations pertaining to coal strip mining and its associated affects on the environment would apply. There are also a number of standard stipulations (minimum mitigating measures) in the current Federal coal lease form (see Chapter 1). The following minimum standards are general and relevant to this analysis:

Topography

1. Disposition of any final highwall shall be determined after consultation with the U. S. Geological Survey, B.L.M., North Dakota State Public Service Commission, and the mining company.
2. All spoils must be graded to the approximate original land topography unless a different contour is decided upon by all involved parties.

Water

3. Dams, ditches, dikes, and canals used for surface water control in and around the mining operation shall be constructed in accordance with approved engineering practices and located so as to do the least amount of environmental damage. Soil material shall be placed on all dams and dikes following construction. These and all areas denuded during construction of water control structures shall be seeded after placement of soil material.

4. All drainage waters discharged into natural drainages must meet State and Federal water quality standards. If necessary, they shall be impounded for chemical and sediment treatment.

5. Flowing springs, wells, and reservoirs which are eliminated by mining shall be replaced with suitable alternative water sources.

Soils

6. Toxic material which could jeopardize reclamation shall be buried at a minimum depth of eight feet below the surface.

7. Soil material to be used in reclamation shall be removed and stockpiled, or placed directly on regraded spoils. Soil material which will be stockpiled for more than one year shall be seeded. Additional protective measures, such as orientation of stockpiles and reduced stockpile slopes, shall be taken to prevent soil loss from wind and water erosion.

Vegetation

8. Seeding and planting composition, rates, and other revegetation criteria will be reviewed at the time of seeding.

9. Seeding will be done as instructed until it has been determined to be successful by the B.L.M. and the North Dakota Public Service Commission.

Animals

10. The active mining areas shall be posted, fenced, or otherwise protected where necessary to minimize injury to people, livestock, and wildlife.

11. Drill holes shall be protected at all times so as to prevent injury to people, livestock, and wildlife. They shall be permanently sealed when the need no longer exists.

Cultural Resources

12. If an archaelogical or historical site is discovered during mining, operations shall immediately cease and the BLM District Manager and other appropriate authorities shall be notified. A reasonable time will be allowed for evaluation and/or removal.

Aesthetic

13. Surface buildings, supporting facilities, haul roads, and other structures which have served their purpose shall be removed and their sites graded and revegetated.

Human Values-Regulatory

14. To prevent or abate environmental pollution, any excessive amounts of pollutants will be prevented from reaching the air, water, or land resources, including surface water sources and ground water aquifers (subsurface geologic strata through which ground water moves). "Excessive amounts" of pollutants means any amount which exceeds the maximum amount permitted by the Federal Water Pollution Control Administration, National Air Pollution Control Administration, and by the appropriate agency of the State of North Dakota.

15. The lessee will be required to comply with all State laws and regulations concerning coal mining, including laws and regulations pertaining to the protection and reclamation of surface resources, and to the protection of the land, air, and water environment, where applicable.

16. Haul roads shall be constructed to the minimum width necessary for efficient and safe operations. Haul roads must have adequate drainage and be constructed consistent with good watershed practices.

Haul roads shall be sprinkled with water when necessary to reduce air pollution from dust. Haul roads shall be located so as not to interfere with proper shaping of spoil piles, and they may double as access roads.

17. All operations shall be conducted so as to avoid range fires and spontaneous combustion. Open burning of carbonaceous materials shall be in accordance with suitable practices for fire prevention and control. The mining company shall take immediate steps to extinguish any fires in piles of coal waste or slack, or in in-place coal.

18. All existing improvements, including but not limited to gates, cattleguards, roads, trails, pipelines, bridges, public land survey monuments, and water development and control structures, shall be replaced, restored, or appropriately compensated for in the event they are damaged or destroyed by company operations.

Land Use

19. Where an excavation is to be left as a permanent water impoundment, accesses appropriate to its use should be provided.

ADDITIONAL POSSIBLE MITIGATING OR ENHANCING MEASURES

The following is prepared as a list of measures that may help to reduce or enhance the impacts identified in the preceding analysis. They are made without regard to the practicality of the actions. In some cases they may not be applicable, but are brought out for consideration only.

Air Quality

1. By keeping all mining equipment properly maintained, the level of exhaust emissions would be reduced. Exhaust emission should be checked with each periodic maintenance of mining equipment.

2. Construction of roads and mine facilities could be limited to the more moist seasons of the year. This would reduce the level of dust that would be expected from these operations.

3. The areas in which permanent roads and facility construction is taking place could be watered, or oiled, to reduce the amount of expected particulate matter.

Topography

4. In the regrading process, undulating terrain could be developed. This would help provide some of the necessary ecological requirements of the endemic wildlife species.

Water

5. During mining, soil erosion and sediment load should be reduced by both surface manipulation and installation of control devices such as settling ponds, water bars, check dams, and culverts.

6. Excess mine water could be pumped into a settling pond and its rate of release controlled. This would help control impacts resulting from increased sediment load, and soil, and stream bank erosion.
7. Prevent buried toxic and other undesirable material from contaminating ground water or coming in contact with infiltrating surface water.
8. Energy dispersion structures could be placed on water courses with accelerated water velocity to reduce water velocity. They would reduce soil erosion, sediment load, and mitigate the impacts on aquatic vegetation and animals.
9. Surface manipulation of topsoiled areas, by techniques such as gouging, dozer basins, and deep chiseling, would increase the water infiltration, interception, and retention capacity. This technique would also have beneficial effects on the hydrologic cycle, such as improving the moisture content available for vegetation, and it would reduce losses from both wind and water erosion.
10. Monitoring of water courses would assist in maintaining water quality in and around the mining site by detecting any potential, or actual existing water problem. This would help reduce the impacts from: increased sediment load, decreased dissolved oxygen, increased dissolved solids, nutrients, chemicals, heavy metals, changes in pH and water temperatures. In order to establish base line data, monitoring should be started prior to new mining and continue into the period following reclamation.
11. Since impacts on ground water aquifers are largely unknown, hydrologic investigations should be initiated to determine the impacts of mining on the aquifers.

Soil

12. The effects of road construction on soil depth could be reduced by stockpiling the topsoil removed and replacing it following closure of the mine.

13. By keeping the regraded spoil piles to a minimum slope, impacts caused by soil erosion and sediment load could be reduced.

14. If possible, avoid mixing any alkaline or calcareous material in the topsoil or subsoil removed. This would reduce the expected impacts on the soil nutrient properties.

15. Soil pollutant property impacts could be reduced by placing alkaline, calcareous, or other toxic material removed in mining well below the surface on reclaimed areas.

16. Overburden which is found to have favorable soil-like properties could be used as subsoil or in place of second lift material. This would reduce impacts on: soil depth, soil structure, hydrologic cycle, and deep rooted terrestrial plant growth.

17. Surface manipulation of regraded spoils prior to topsoiling would reduce the chance of topsoil slippage and improve infiltration rates.

18. Upon replacement of topsoil, the second lift (mainly "B" horizon material) should be laid down first, and the first lift (or "A" horizon material) spread over it. This would reduce the impact on soil structure and nutrients.

19. Once topsoiling has been completed, any operation which would tend to mix excessive amounts of topsoil with the underlying regraded spoils should be avoided.

20. Impacts to the soil structure could be reduced by practicing minimum tillage on the reclaimed areas.

21. The use of fertilizers to establish an effective vegetative cover should follow guidelines established through soil testing. Quick establishment of a vegetative cover would reduce wind and water erosion and would aid in the re-establishment of soil nutrients and soil structure.

22. By applying mulch to new seeding in reclaimed mine areas, a more favorable growth environment would be provided, evaporation rates would be reduced, and valuable organic matter would be supplied to the soil, thereby providing for quicker revegetation and reduction of both wind and water erosion.

23. By placing a mulch with seeding on road cuts the amount of soil erosion and sediment load could be reduced. This could also facilitate revegetation.

24. Revegetating with both shallow and deep rooted plant species would improve the soil structure.

25. Herbicides and pesticides should be used only when deemed absolutely necessary to assure reclamation success, and then only with extreme caution. This safeguard would help keep soil, water, and forage qualities relatively high and free of pollutants.

Vegetation

26. The site could be surveyed for officially endangered plants and animals.

27. Significant aquatic and riparian habitat should be avoided during mining when reasonably possible. In the reclamation process, all

aquatic habitat lost to the mining operation should be replaced. New permanent deep water ponds could be developed in the regraded spoils areas during reclamation. Where wet areas are created aquatic plants should be seeded. Properly designed ponds would create fisheries and aquatic wildlife habitat. This would provide new habitat and diversify existing wildlife conditions. It would enhance recreation by providing new opportunities.

28. The construction of shallow impoundments (dams in natural drainage-basin areas) would also help enhance aquatic habitat. Such impoundments present seasonal, semipermanent or permanent wetland characteristics. A strip of herbaceous cover at least 2 rods wide should surround such impoundments, and be protected from livestock grazing by fencing.

29. If studies could be made with regard to the replacement of wetland habitat this would be a significant enhancing measure not only for this mine, but for other mines throughout the area. Cooperation between the mining company and the U.S.F.&W.S. with regard to funding and research objectives and procedures is a viable consideration.

30. Diverse, native, terrestrial plant species (grasses, forbs, shrubs, and trees) should be replanted in the appropriate sites during the reclamation process as soon as suitable conditions exist. This measure should reduce the time the area is without vegetation and minimize aesthetic impacts.

31. During reclamation, trees and shrubs should be transplanted to areas where they presently exist or where suitable sites occur.

This would mitigate aesthetic impacts, in addition to providing food and cover for wildlife. Woody plants could be a combination of clump plantings (¼ to 1 acre), block plantings (4 to 10 acres), ponded water border plantings, two row shrub travel lane plantings, and odd area woody plantings. Native woodland habitat should be considered for replacement on a 2 to 1 basis.

Between-the-row cultivation should be considered for tree plantings which would be developed on relatively level sites. Where soil erosion is a definite site problem, native grass should be planted on the site prior to tree planting <u>or</u> a tree planting herbaceous seed mixture should be seeded between the planted tree rows.

32. During reclamation, supplemental irrigation should be used until the revegetation has been determined successful by BLM and North Dakota State PSC.

33. No grazing should be allowed on reclamation plantings until the vegetation is well established and can be expected to withstand grazing pressure. This measure should promote successful vegetation establishment.

34. On those areas to be grazed after reclamation is completed, carefully monitored management procedures should be instituted. This action would assure permanent reclamation success through vegetation establishment.

<u>Ecological Processes</u>

35. During reclamation, various vegetation life forms should be planted in a manner which provides for maximum diversity and interspersion.

Cultural Resources

36. Any cultural resource mitigating measures must be preceeded by an intensive cultural resource survey to locate sites in the lease application area. After the resources are located and tested, the archaeologists in charge of the survey and BLM cultural resource personnel would evaluate any sites found. The criteria for evaluation of sites are those established for considering the resource's potential for placement on the National Register of Historic Places (Appendix 4). Any sites considered to have National Register potential would be referred to the North Dakota State Historic Preservation Officer. Potential National Register quality sites would then be forwarded to the National Park Service for placement on the Register if qualified.

If any cultural resource in the lease application area is found eligible for inclusion on the National Register, it must be referred to the Advisory Council on Historic Preservation for comment prior to any Federal decision affecting the resource in compliance with the National Historic Preservation Act of 1966 and Executive Order 11593. This comment must be considered in the final decision regarding the lease application.

From the interchange among Federal agencies, the State Historic Preservation Officer and, if warranted, the Advisory Council on Historic Preservation, decisions would be made regarding any cultural resources found in the survey. Measures to take into account, avoid, or mitigate the loss of archaeologic and historic information would be formulated as stipulations to the lease, if approved.

Aesthetics

37. The boundary of the mined area should be "varied" or "feathered" during reclamation. This would reduce the strong contrast between mined and unmined areas and partially mitigate the impact on aesthetic values.

Recreation

38. New recreation facilities (campgrounds, picnic areas, etc.) should be developed on suitable sites near Stanton and the Missouri River. This would partially mitigate the impacts of increased recreation demands created by expanding mining activities.

Socio-Economic

39. If the lease applicant complies with the mitigating and enhancing measures recommended in other sections of this chapter, potential socio-economic impacts will also be mitigated. Proper reclamation should leave the land as economically productive as before mining. Successful reclamation will also promote positive public sentiment toward the mining effort.

A measure which is not enforceable, but which may promote positive public attitudes toward the mining industry and mitigate future economic impacts involves planning. Governmental planning should be taking place on all levels to mitigate fiscal and social impacts of the future decline in mining operations. As coal is depleted in the area, government and the public should be prepared to deal with probable declines in job, population, and revenues.

Human Values-Regulatory

40. Although possibly not a true "mitigating" measure, but rather, a lease alternative, the regulatory authority of the BLM leasing officials to selectively deny unsuitable lease tracts (i.e., the on-site existence of critical or sensitive vegetative components, or excessively steep slopes, etc.) functions as a defacto mitigating measure.

Land Use

41. In order to mitigate the impacts on the land use compatibility component, it would be necessary to put the land back into compatible uses as quickly as feasible.

CHAPTER 5

RESIDUAL ADVERSE IMPACTS

Assuming that recommended mitigating and enhancing measures are applied, there would still be impacts which cannot be mitigated or which cannot be completely mitigated. This Chapter discusses those impacts.

CLIMATE AND AIR QUALITY

Microclimatic changes would occur if the vegetation and topsoil is removed. Air temperatures would increase. Air movement patterns close to the ground surface would be affected until vegetation is re-established. Fugitive dust levels would increase because of mining and reclamation operations. These impacts would be negligible. Diesel and gasoline powered equipment used during the mining and reclamation phases would contribute an insignificant increase in exhaust emissions.

GEOLOGY

Since the impacts to the geology component described in Chapter 3 cannot be mitigated, these impacts then carry over as residual adverse impacts. Upon removal, the integrity of the geologic strata comprising the overburden, coal bed, and the paleontological values enclosed within them, would be destroyed. The lignite is a non-renewable natural resource which once depleted is lost forever.

TOPOGRAPHY

The impacts of strip mining on topography would not be completely mitigated during reclamation since it will be impossible to reclaim the lands to exactly their original condition. On the whole, the reclaimed topography would consist of lower sloped landforms.

WATER

In spite of the mitigating measures incorporated, the water component of the environment of the Glenharold mine would be changed during mining. The resultant impacts caused by many of these changes are either largely unknown or of low significance.

Certain variables, such as sediment load, water-borne nutrients, dissolved solids, pH, and toxic materials may be increased in surface and ground waters because of increased permeability and porosity in regraded spoil and topsoil material. Foreign chemicals, such as nitrates, may be introduced into the environment during blasting of the overburden and the coal seam.

SOILS

The existing natural character of the soil would be destroyed by mining and reclamation. In its place a new soil would develop. The soil structure would be virtually destroyed through handling operations. The nutrient cycle would be disrupted by the unavoidable mixing of the organic matter with other soil materials. This would be partly alleviated by removing the topsoil and subsoil in separate lifts. Micro and macro organism activity would be partly destroyed and altered. Some of the soils in the Glenharold mine area would be affected by excess sodium and/or soluble salts as it is not possible to identify and bury 100% of these due to equipment and identification limitations. Water and air movement patterns in the soil would be drastically changed. Soil depth over the reclaimed area would be more uniform than previously existed. In the Glenharold mine area, about 60% of the soils over federal coal are shallow. These areas would benefit as they would receive additional soil from other areas. The mixing of various soil textures would be beneficial in some cases, e.g., mixing sandy soils with clayey ones, and detrimental in others. Some soil would be lost because of water erosion.

VEGETATION

The present vegetation complex would never be "restored" thus creating an adverse residual impact. The exact set of circumstances which led to the creation of the present vegetation complex is very unlikely to be repeated (i.e., range fires, floods, herbivore grazing pressure, soils and topographic positioning, regional climatic and microclimatic occurrences, etc.). Therefore, the pre-mining vegetation complex would not be replaced after mining. The reclamation process would replace some of the functional aspect of the existing vegetation.

ANIMALS

Residual impacts on wildlife would closely parallel those of vegetation. Only when the habitat is replaced, can the endemic wildlife species be expected to return to the mined areas.

ECOLOGICAL PROCESSES

Succession is a continuous process which constantly proceeds toward "climax" in the natural state. It takes many years for the vegetation complex to reach climax and this "lag" period (expressed as seral stages) represents a residual impact of strip mining. In addition, the changed relief and soil character of the mined areas dictates a new local climax. Food and community relationships, as with the animals themselves, would closely parallel and reflect the vegetation communities re-established on the mined areas.

CULTURAL RESOURCES

The cultural resource survey and mitigation process described in Chapter 4 would minimize the loss of cultural values from mining. Archaeological surveys, no matter how intensive, may fail to locate all sites. Vegetation may cover surface evidence of cultural resources. Similarly, cultivated lands may obscure sites and there is always the possibility that cultural material is entirely subsurface. Those sites not discovered during the preliminary survey would be lost and thus create a residual adverse impact.

Additional residual impacts may be apparent after the cultural resource survey and evaluation is completed.

AESTHETICS

There would be a slight increase in noise levels and visual disturbances during the time required to mine and reclaim the proposed lease area. They would occur on adjoining areas regardless of whether the federal coal is leased or not.

The major impact following reclamation would be a slight change in land form. The general topography would be reduced to a gentler (more rolling and undulating) form than presently exists.

RECREATION

The 480 acres in the proposed lease would be lost to recreation opportunities (primarily hunting) during the mining period. These losses would partially occur even if the lease is not granted because of on-going mine operations on adjoining lands.

SOCIO-ECONOMIC CONDITIONS

The economic suitability of the land after mining would depend on the success of reclamation. If this effort is not successful, the land may not be suitable for future farming or grazing. Failure of reclamation would constitute an adverse residual socio-economic impact.

If the lease application is not approved and the federal coal is bypassed, it may never be utilized. The cost of extracting this coal after contiguous areas have been mined and reclaimed may be prohibitive.

LAND USE

With proper rehabilitation practices, there should be no residual adverse impacts.

CHAPTER 6

SHORT TERM USES VS. LONG TERM PRODUCTIVITY

The short term is that period during which the substantive part of the proposed action takes place. In the case of the Glenharold Mine, this would begin with the lease of Federal coal, and end with successful reclamation in the mid 1980's. The long term is that period beyond successful reclamation during which impacts may still occur.

CLIMATE AND AIR QUALITY

The short term use of the environment for mining would change the long term microclimate following reclamation. This change is not expected to have a long term effect on productivity.

Air quality would not be changed in the long term by the short term use of the area for coal mining.

GEOLOGY

The long term effects of mining on the long term productivity are somewhat speculative. With the high degree of reclamation technology available, it is reasonable to assume that the long term productivity of the land may reach pre-mining productivity.

TOPOGRAPHY

The land may be more adaptable to agricultural uses after mining and reclamation. The reclaimed land would contain lower and gentler-sloped landforms more amendable to farm vehicular travel. Therefore, mining (with proper reclamation) when viewed as a short term use, may increase long term agricultural productivity.

WATER

Although mining may result in residual impacts on the water component, it would have negligible effects on the long term productivity of water.

SOILS

The short term use of the environment for mining is not expected to change the long term productivity of the soils. It would take many years to re-establish soil structure. The composition would never be the same. It is expected that reclamation and the addition of amendments would result in soils with a productivity similar to that prior to mining.

VEGETATION

Within the framework of a strip mine, there is no short term use for vegetation. The relationship of long term productivity to vegetation is largely undetermined. Since agricultural lands are often fertilized and artifically sustained, it seems reasonable to assume, those areas would probably regain their original productivity. With present reclamation emphasis on agriculture, it seems likely that the existing native rangeland areas would not achieve their original productivity. If the original productivity of these sites is achieved, it would undoubtedly take many years.

ANIMALS

As with vegetation, there is no short term use for wildlife within the scope of strip mine activities. If wildlife habitat requirements are replaced in the reclamation process, very little residual wildlife impact would exist. Therefore, wildlife productivity would not necessarily be reduced in the long term. If a diversity of native habitats are not replaced during reclamation, the long term productivity of native wildlife populations could experience a significant reduction.

ECOLOGICAL PROCESSES

Ecological processes are a function, rather than a resource; thus are intangible. Therefore, short term use and long term productivity are not applicable to ecological processes, as they are to tangible resources.

CULTURAL RESOURCES

If destroyed or altered, the non-renewable cultural resources would be lost forever.

AESTHETICS

Short term use of the land for mining would have only a minor effect on long term scenic values. The land form would be changed slightly but, with adequate reclamation, the visual character of the lands could be returned to approximately their original condition.

RECREATION

Short term use of the land for mining should not affect the long term production for recreation. Mining would eliminate the land from all possible recreation uses during the mining period. The proposed lease area would, for the most part, be lost for this use anyway as a result of on-going mining on adjacent lands. All existing recreation opportunities would be available upon successful completion of reclamation.

SOCIO-ECONOMIC CONDITIONS

Between the time the federal coal is mined and the completion of reclamation, the land would not be suitable for economic activities other than mining. If reclamation is successful, current land uses could be resumed with no adverse socio-economic effects.

LAND USE

The area would be lost for all uses except mining during the short term. In the long term, proper reclamation should return the land to its original productivity.

CHAPTER 7

IRREVERSIBLE ACTIONS AND IRRETRIEVABLE RESOURCE COMMITMENTS

Irreversible actions are those actions or processes that would occur as a result of project implementation. Irretrievable resource commitments are those resource commitments or losses which would occur as a result of the actions.

CLIMATE AND AIR QUALITY

None of the actions in the proposal would result in an irretrievable commitment of resources in this component of the environment.

GEOLOGY

Permission to allow strip mining of the lignite is an irreversible action concerning a public resource. Once it is mined, this non-renewable natural resource is lost forever.

TOPOGRAPHY

Irreversible changes and irretrievable losses would occur, irrespective of the amount of energy and money expended to reclaim the mined area, because it would be nearly impossible to re-establish the original topography.

WATER

Irreversible impacts may occur on some water components as the result of mining. Most of the effects are unknown. Mining would result in an irretrievable loss of part of the local aquifer systems. However, mining in adjacent areas has already truncated portions of these aquifers.

SOILS

Soil is a dynamic "living body. Following mining and reclamation, the soil as it was previously known would no longer exist. It would not be destroyed, but rather altered considerably, and over a period of time would again develop its own unique set of qualities, properties, and characteristics. Some of the changes may be beneficial, others detrimental.

VEGETATION

Strip mining is an irreversible action which would cause the irretrievable loss of the existing on-site vegetation. The reclamation process, however, would have a secondary effect by replacing a substitute vegetation, and thereby, restoring part of the functional aspect of the pre-mining vegetation complex. Depending on the emphasis of reclamation (i.e., post-mining topography, soil profile, etc.), future vegetation use options (i.e., wildlife habitat, cropland, etc.) may, or may not, be eliminated.

ANIMALS

The impacts and rationale of strip mining on wildlife are identical to those of vegetation in regard to the irreversible actions and irretrievable commitment of resources.

ECOLOGICAL PROCESSES

Since succession is a continuous process, strip mining represents a revocable action and change in land use. The mining activity merely sets back succession, and does not destroy the process. The impacts of mining on food and community relationships would parallel that of the succession process. The reclamation emphasis (i.e., final topography, etc.) and ultimate land use would control the progression of these ecological functions.

CULTURAL RESOURCES

If the lease application is approved, the removal of topsoil and overburden would become irreversible actions of the mining operation and cause the irretrievable destruction of any cultural resources in the lease application area. Even as information is extracted from the resource by scientific techniques, the sites would be irretrievably lost. Valuable information may be extracted in the mitigation process, but the resource itself would be destroyed.

AESTHETICS

Mining would result in an irreversible change in the land form which would slightly reduce aesthetic values. This is considered insignificant in view of the on-going mining activities adjacent to the proposed lease.

RECREATION

If reclamation efforts are successful, there would not be any irreversible or irretrievable commitment of recreation resources.

SOCIO-ECONOMIC CONDITIONS

The approval of the lease application would precipitate the series of mining operations outlined in Chapter 1. These operations would become irreversible actions, but would not cause irretrievable resource commitments in the socio-economic sector. Changes in lifestyles and public attitudes would not be altered significantly by the proposed action because it would occur in an area already experiencing coal development.

LAND USE

With proper reclamation after mining, the land should be returned to a condition equal to or better than its original state. Thus, there should be no irreversible actions and irretrievable resource commitments.

CHAPTER 8

ALTERNATIVES TO THE PROPOSED ACTION

NO ACTION

Description of Alternative

The alternative to the proposed action is to refuse to lease the 480 acres of coal requested in the applicant's lease amendment and to continue mining without Federal coal. This action would maintain the coal in Federal ownership, and would require that the applicant mine around the subject tracts. It would not keep mining related activities off the tracts, because the applicant controls the surface over Federal coal. The BLM has no jurisdiction or authority beyond leasing the Federal coal and insuring reclamation of the leased area following mining. The North Dakota Public Service Commission maintains control of mining activities under these circumstances.

Refusal to lease the subject tracts would not prevent the continued development at the Glenharold mine. The applicant has sufficient reserves to supply its commitments for the next several years, sooner or later however, in order for the mine to operate to its full life expectancy some Federal coal would be needed. In all probability, if the tracts are bypassed at this time, they would not be leased at a future date due to the expense involved in returning to mine isolated tracts. Mining these tracts in the future would involve basically the same expenses as those involved with moving to a new location, and starting a new pit. It would entail redeveloping the road system, and disturbance of reclaimed land adjacent to the tracts. To make this a worthwhile undertaking, the economics would have to improve drastically.

Environmental Analysis

The environmental impacts of the alternatives are similar, for the most part, to those discussed in Chapter 3. This section will deal only with those that differ from the impacts previously discussed.

Non-lease of the Federal coal would impact the land use component of the environment. By refusing to lease the 480 acres, the applicant would mine around the coal. This would result in an obstacle to a logical mining and reclamation sequence. It would also result in isolated tracts of minable coal either on the edge or within a completely mined area. Because of the limited and scattered nature of the area involved, the value of the coal would have to drastically change before the coal on these tracts would be valuable enough to return at a later date and mine. Because of this the coal would be lost for the forseeable future.

The socio-economic subcomponent would also be impacted to a limited degree. The people of the United States and the State of North Dakota would be denied the revenue generated from royalties and lease income by this alternative.

Mining and reclaiming around the tracts would increase the cost of mining as well as reclamation. These increases must ultimately be borne by the consuming public.

Mitigating or Enhancing Measures

There have been no mitigating measures identified that would reduce the expected impacts of this alternative beyond those previously discussed in Chapter 4.

Residual Adverse Impacts

Isolated tracts of minable coal would be left within or along the edge of an otherwise totally mined area.

The people of the United States and the State of North Dakota would be denied the royalties and lease income generated from the leases.

Mining and reclamation costs would be increased.

Short Term Uses vs. Long Term Productivity

The short term is the remaining life of the mine. The long term is that period beyond the life to the mine. The decision to not lease the Federal coal would not affect the short term and would maintain the long term productivity of the tract.

Irreversible Action and Irretrievable Resource Commitments

Due to the economics involved refusal to lease the subject coal tracts would commit the Federal coal to nonuse for the foreseeable future.

CHAPTER 9

CONSULTATION AND COORDINATION

The following persons and organizations were contacted during the preparation of this environmental analysis record. Most of the information was used in the preparation of Chapters 1 and 2.

1. Dr. William Barker - North Dakota State University, Fargo, North Dakota.
2. Dr. Paul Kannowski - Institute for Ecological Studies, University of North Dakota, Grand Forks, North Dakota.
3. Robert Morgan - North Dakota Game and Fish Department, Bismarck, North Dakota.
4. Refuge Headquarters, U. S. Fish and Wildlife Service - Audobon National Wildlife Refuge, Coleharbor, North Dakota.
5. Area Office, U. S. Fish and Wildlife Service - Bismarck, North Dakota.
6. Nick Franke - Research Archaeologist, State Historical Society of North Dakota, Bismarck, North Dakota.
7. Dee Galt - Soil Conservation Service, State Office, Bismarck, North Dakota.
8. Soil Conservation Service - P. O. Box 466, Hazen, North Dakota.
9. Consolidated Coal Company - Richard Huschka, Environmental Engineer.
10. North Dakota State Water Commission - Dave Ripley, Ground Water Hydrologist; Dave Sprynczynatyk, Hydrologic Engineer.

CHAPTER 10

INTENSITY OF PUBLIC INTEREST

The intensity of public interest in the subject Federal coal lease amendment is presently unknown. Past BLM experience with similar coal leases in this area indicated public response to be variable and directed primarily at the issue of coal development, rather than at the lease of the specific tracts of Federal coal. This draft environmental analysis record will be distributed to the general public for comment. The response comments to the draft document should help establish a "feeling" for the intensity and direction of the existing public sentiment and concern with the proposed Federal coal lease.

APPENDIX 1

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APPENDIX 2

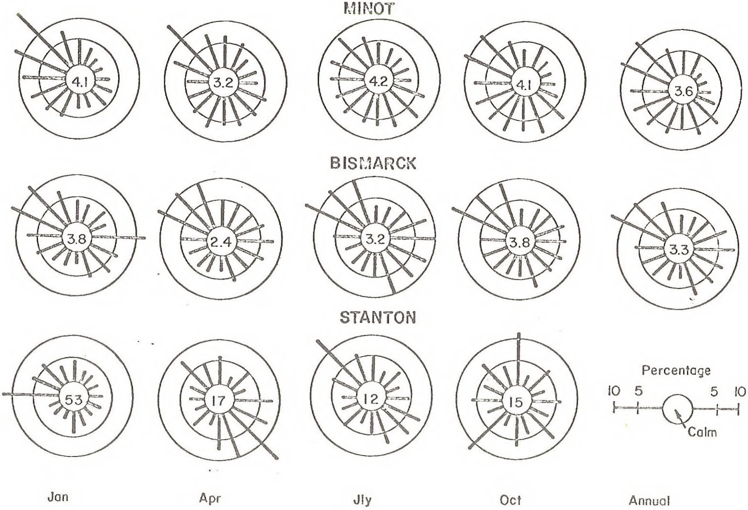
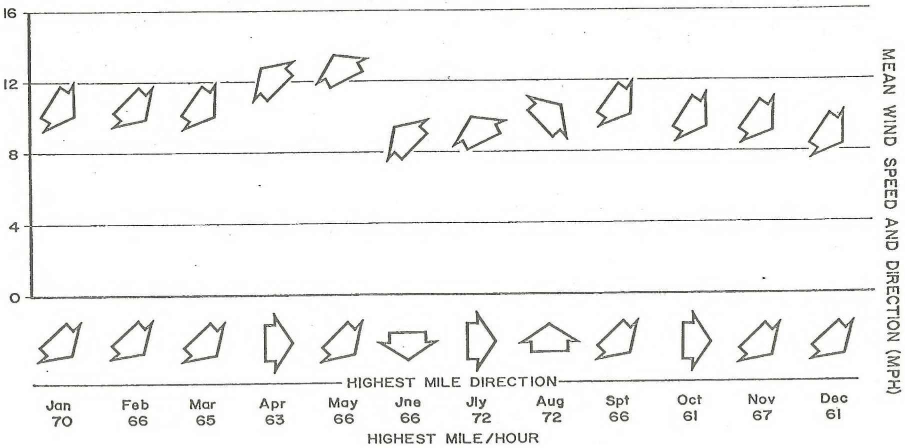


FIGURE A2-1
WIND ROSES –
MINOT, BISMARCK, AND STANTON

NATURAL GAS PIPELINE COMPANY OF AMERICA

DAMES & MOORE

FIGURE A2-2

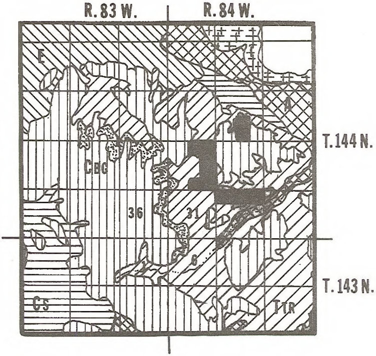


MONTHLY AVERAGE AND HIGHEST WIND SPEEDS, DUNN COUNTY

NATURAL GAS PIPELINE COMPANY OF AMERICA

NOTE: INTERPOLATED FROM NEARBY WIND STATIONS.

Figure A2-3. Geologic Map of the Glenharold Mine Area
(After Carlson, 1973)



LEGEND

			Missouri River
			Proposed Coal Lease Tracts
Holocene	Walsh Formation	A	Floodplain - Terrace deposits; dark brown, gray or black silt, clay, and sand.
		E	Sand dunes; well sorted, fine to medium grained sand.
Quaternary	Coleharbor Formation	Cs	Alluvial terrace deposits; well sorted, fine to medium grained sand; some gravel.
		CBG	Ground Moraine; low or no glacial constructional relief, mostly slightly modified bedrock topography.
Tertiary	Sentinel Butte Formation	TSB	Bedrock; interbedded silt, clay, lignite, sand, and shale.
	Tongue River Formation	TTR	Bedrock; interbedded sand, silt, clay, lignite, and shale.

Era	System	Sequence	Group or Formation		Dominant Lithology	
Cenozoic	Tertiary	Tejas		Walsh	Silt, clay and sand	
				Colcharbor	Sandy loam, sand and gravel	
		Zuni		Golden Valley	Clay, sandstone and lignite	
			Fort Union Group	Sentinel Butte	Shale, clay, sandstone and lignite	
				Tongue River	Shale, sandstone and lignite	Coal GW
				Cannonball-Ludlow	Marine sandstone and shale	GW
Mesozoic	Cretaceous			Hell Creek	Sandstone, shale and lignite	
			Montana Group	Fox Hills	Marine sandstone	GW
				Pierre	Shale	
			Colorado Group	Niobrara	Shale, calcareous	
				Carlile	Shale	
				Greenhorn	Shale, calcareous	
				Belle Fourche	Shale	
			Dakota Group	Mowry	Shale	
				Newcastle	Sandstone	
				Skull Creek	Shale	
				Fall River	Sandstone and shale	
				Lakota	Sandstone and shale	
	Jurassic			Morrison	Shale, clay	
				Sundance	Shale and sandstone	
				Piper	Limestone, anhydrite, salt and red shale	
	Triassic	Absaroka		Spearfish	Siltstone, salt and sandstone	
Paleozoic	Permian			Minnekahta	Limestone	
				Opeche	Shale, siltstone and salt	
	Pennsylvanian			Minnelusa	Sandstone and dolomite	
				Amsden	Dolomite, limestone, shale and sandstone	
				Tyler	Shale and sandstone	
	Mississippian	Kaskaskia		Otter	Shale, sandstone and limestone	
				Kibbey		
				Madison	Interbedded limestone and evaporites	
					Limestone	
				Bakken	Siltstone and shale	
				Three Forks	Shale, siltstone and dolomite	
	Devonian			Birdbear	Limestone	
				Duperow	Interbedded dolomite and limestone	
				Souris River	Interbedded dolomite and limestone	
				Dawson Bay	Dolomite and limestone	
				Prairie	Halite	
				Winnipegosis	Limestone and dolomite	
	Silurian	Tippecanoe		Interlake	Dolomite	
	Ordovician			Stonewall	Dolomite and limestone	
			Stony Mountain Formation	Gunton Member	Limestone and dolomite	
				Stoughton Member	Argillaceous limestone	
				Red River	Limestone and dolomite	
			Winnipeg Group	Roughlock	Calcareous shale and siltstone	
				Icebox	Shale	
				Black Island	Sandstone	
	Cambrian	Sauk		Deadwood	Limestone, shale and sandstone	
	Precambrian					

FIGURE NO. A2-4. Stratigraphic column for Mercer and Oliver Counties (from Carlson 1973).

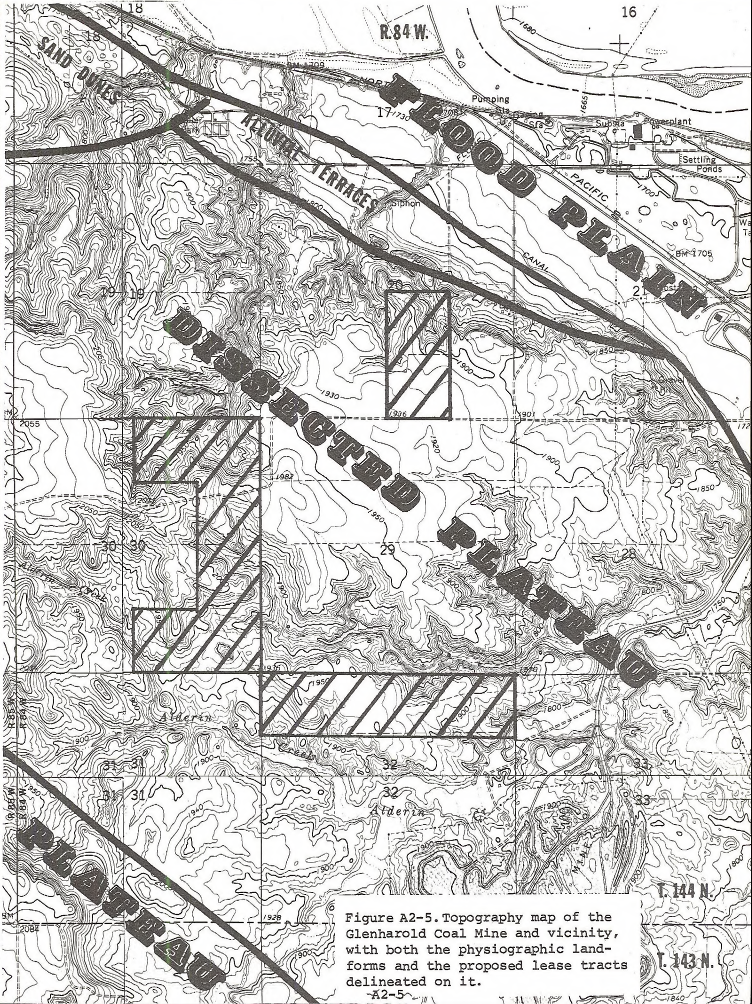
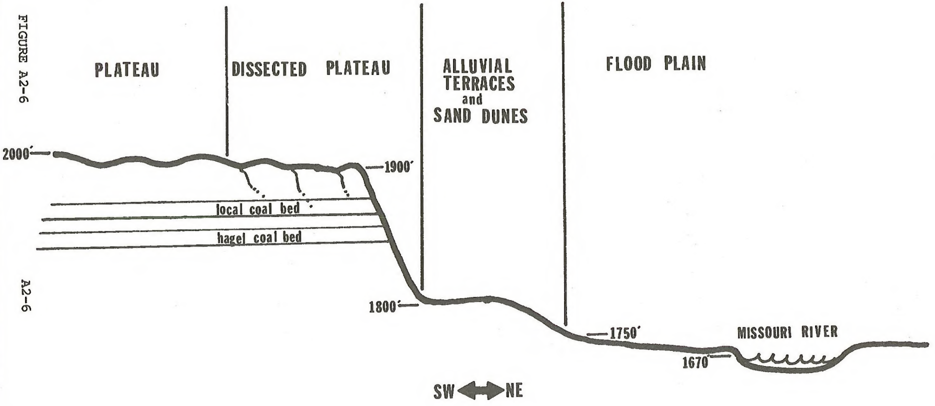


Figure A2-5. Topography map of the Glenharold Coal Mine and vicinity, with both the physiographic landforms and the proposed lease tracts delineated on it.

FIGURE A2-6



Physiographic Cross Section and Landform Units
Consol – Glenharold Mine
Stanton, North Dakota

Form 1600–6
(August 1969)

DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

PHYSICAL PROFILE
HYDROLOGIC DATA

Unit USGS surface water monitoring station # 6-338490 - Missouri River at Garrison Dam.	Date 1974 By U.S. Geological Survey		
ITEM	UNIT	ESTIMATED ANNUAL AMOUNT	SOURCE REFERENCE*
1. Water Yield †	cfs	18400-38700	# 1
2. Water Use †			
3. Sediment Production		INFORMATION NOT AVAILABLE	
4. Other Pollutants ‡			
a. Silica (SiO_2) dissolved	mg/l	6.2 - 8.0	# 1
b. Aluminum (Al) total	ug/l	200 - 900	# 1
c. Aluminum (Al) dissolved	ug/l	0 - 10	# 1
d. Iron (Fe) dissolved	ug/l	30 - 80	# 1
e. Manganese (Mn) dissolved	ug/l	0 - 67	# 1

Remarks

1 U. S. Geological Survey, "Water Resources Data for North Dakota", Part 2. "Water Quality Records", 1974

† 1 cu. ft./sec (cfs) = 2 ac. ft./day = 730 ac. ft./year. 1 gal./min = .00223 cfs = 1.63 ac. ft./year.

‡ Show total mean annual concentration of all salts on line 4. List mean annual concentration of major salts on lines 4a, b, c, etc.

* If additional space is required, footnote under "Remarks"

TABLE A2-1

GPO 852 - 688

Form 1600-6
(August 1969)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

PHYSICAL PROFILE
HYDROLOGIC DATA

Unit
USGS # 6-338490 Continued

Date
By

ITEM	UNIT	ESTIMATED ANNUAL AMOUNT	SOURCE REFERENCE*
f. Calcium (Ca) dissolved	mg/l	41 - 65	# 1
g. Magnesium (Mg) dissolved	mg/l	16 - 23	# 1
h. Sodium (Na) dissolved	mg/l	48 - 66	# 1
i. Potassium (K) dissolved	mg/l	3.7 - 4.6	# 1
j. Bicarbonate (HCO_3)	mg/l	174 - 198	# 1
k. Carbonate (CO_3)	mg/l	0 - 8	# 1
l. Alkalinity ($CaCO_3$)	mg/l	143 - 162	# 1
m. Sulfate (SO_4)	mg/l	120 - 190	# 1
n. Chloride (Cl) dissolved	mg/l	6.3 - 11.0	# 1
o. Fluoride (F) total	mg/l	.5 - 1.5	# 1
p. Fluoride (F) dissolved	mg/l	.4 - 1.1	# 1
q. Nitrite + Nitrate (N) total	mg/l	.08 - .22	# 1
r. Ammonia Nitrogen (N)	mg/l	.01 - .06	# 1
s. Organic Nitrogen (N) total	mg/l	.20 - .64	# 1
t. Nitrogen (N) total	mg/l	.35 - .83	# 1
u. Nitrogen (NO_3) total	mg/l	1.6 - 3.7	# 1
v. Nitrite + Nitrate (N) dissolved	mg/l	.03 - .39	# 1
w. Phosphorus (P) dissolved	mg/l	.01 - .03	# 1
x. Total Dissolved Solids (TDS)	mg/l	412 - 470	# 1
y. Hardness (Ca, Mg)	mg/l	170 - 250	# 1
z. NonCarbonate Hardness	mg/l	26 - 90	# 1

† 1 cu. ft./sec (cfs) = 2 ac. ft./day = 730 ac. ft./year. 1 gal./min = .00223 cfs = 1.63 ac. ft./year.

‡ Show total mean annual concentration of all salts on line 4. List mean annual concentration of major salts on lines 4a, b, c, etc.

* If additional space is required, footnote under "Remarks"

TABLE A2-1 continued.

Form 1600-6
(August 1969)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

PHYSICAL PROFILE
HYDROLOGIC DATA

Unit
USGS # 6-338490 continued

Date

By

ITEM	UNIT	ESTIMATED ANNUAL AMOUNT	SOURCE REFERENCE*
aa. Sodium	%	35 - 38	# 1
bb. Sodium Absorption Ratio (SAR)	----	1.6 - 1.8	# 1
cc. Specific Conductance (SC)	micro-mhos	640 - 720	# 1
dd. pH	units	8.0 - 8.5	# 1
ee. Color (Platinum Cobalt Units)	----	3 - 20	# 1
ff. Dissolved Oxygen	mg/l	8.4 - 11.0	# 1
gg. Arsenic (As) dissolved	ug/l	0 - 4	# 1
hh. Barium (Ba) dissolved	ug/l	0 - 100	# 1
ii. Beryllium (Be) dissolved	ug/l	0	# 1
jj. Boron (B) dissolved	ug/l	100 - 170	# 1
kk. Cadmium (Cd) dissolved	ug/l	0 - 2	# 1
ll. Chromium (Cr) dissolved	ug/l	0 - 10	# 1
mm. Cobalt (Co) dissolved	ug/l	0 - 2	# 1
nn. Copper (Cu) dissolved	ug/l	2 - 7	# 1
oo. Lead (Pb) dissolved	ug/l	0 - 6	# 1
pp. Lithium (Li) dissolved	ug/l	40 - 60	# 1
qq. Mercury (Hg) dissolved	ug/l	0 - .1	# 1
rr. Mercury (Hg) total	ug/l	0 - .1	# 1
ss. Molybdenum (Mo) dissolved	ug/l	1 - 3	# 1
tt. Nickel (Ni) dissolved	ug/l	0 - 3	# 1
uu. Selenium (Se) total	ug/l	0 - 1	# 1

† 1 cu. ft./sec (cfs) = 2 ac. ft./day = 730 ac. ft./year. 1 gal./min = .00223 cfs = 1.63 ac. ft./year.

‡ Show total mean annual concentration of all salts on line 4. List mean annual concentration of major salts on lines 4a, b, c, etc.

* If additional space is required, footnote under "Remarks"

TABLE A2-1 continued

GPO 852 - 688

Form 1600–6
(August 1969)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

PHYSICAL PROFILE
HYDROLOGIC DATA

Unit
USGS # 6-338490 continued

Date

By

ITEM	UNIT	ESTIMATED ANNUAL AMOUNT	SOURCE REFERENCE*
vv. Selenium (Se) dissolved	ug/l	0 - 2	# 1
ww. Silver (Ag) dissolved	ug/l	0	# 1
xx. Strontium (Sr) dissolved	ug/l	470 - 560	# 1
yy. Vanadium (V) dissolved	ug/l	.2 - .8	# 1
zz. Zinc (Zn) total	ug/l	20 - 430	# 1
aaa. Zinc (Zn) dissolved	ug/l	0 - 80	# 1

† 1 cu. ft./sec (cfs) = 2 ac. ft./day = 730 ac. ft./year. 1 gal./min = .00223 cfs = 1.63 ac. ft./year.

‡ Show total mean annual concentration of all salts on line 4. List mean annual concentration of major salts on lines 4a, b, c, etc.

* If additional space is required, footnote under "Remarks"

TABLE A2-1 continued

Major Groundwater Aqufers and Their Relation to Geologic Formations

LAND SURFACE

AQUIFER	FORMATION
	Sentinel Butte
	Tongue River
Lower Tongue River	
	Cannonball and Ludlow Undifferentiated
Upper Hell Creek and Lower Cannonball - Ludlow	
	Hell Creek
Fox Hills and Basal Hell Creek	
	Fox Hills
	Pierre

SEA LEVEL

TABLE A2-2

Form 1600–6
(August 1969)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

PHYSICAL PROFILE
HYDROLOGIC DATA

Unit	
Fox Hills and Basal Hell Creek Aquifer	Date 1968 By

ITEM	UNIT	ESTIMATED ANNUAL AMOUNT	SOURCE REFERENCE*
1. Water Yield †	gal/min	25 - 150	# 2
2. Water Use †	ac. ft.		# 1
3. Sediment Production	cu. yds.	NOT AVAILABLE	
4. Other Pollutants ‡	ppm		
a. TDS	ppm	1230-1990	# 2
b. Chloride	ppm	29-561	# 2
c. Fluoride	ppm	.7 - 6.0	# 2
d. Boron	ppm	1.7 - 3.5	# 2
e. SAR	ppm	70 +	# 2

Remarks

1. Current and Potential Water Use; domestic and industrial.

2. M. G. Croft, US Geological Survey, "Ground Water Resources, Mercer and Oliver Counties, North Dakota," 1973, Part III.

† 1 cu. ft./sec (cfs) = 2 ac. ft./day = 730 ac. ft./year. 1 gal./min = .00223 cfs = 1.63 ac. ft./year.

‡ Show total mean annual concentration of all salts on line 4. List mean annual concentration of major salts on lines 4a, b, c, etc.

* If additional space is required, footnote under "Remarks"

TABLE A2-3

GPO 852 - 688

Form 1600-6
(August 1969)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

PHYSICAL PROFILE
HYDROLOGIC DATA

Unit	Date 1968		
Upper Hell Creek and Lower Cannonball-Ludlow Aquifer	By		

ITEM	UNIT	ESTIMATED ANNUAL AMOUNT	SOURCE REFERENCE*
1. Water Yield †	gal/min	100	# 2
2. Water Use †	ac. ft.		# 1
3. Sediment Production	cu. yds.	NOT AVAILABLE	
4. Other Pollutants ‡	ppm		
a. TDS	ppm	1510-1890	# 2
b. Chloride	ppm	119-381	# 2
c. Fluoride	ppm	.8 - 2.2	# 2
d. Boron	ppm	1.3 - 2.4	# 2
e. SAR	ppm	Very High	# 2

Remarks

1. Current and Potential Water Use; domestic and industrial.

2. M. G. Croft, US Geological Survey, "Ground Water Resources, Mercer and Oliver Counties, North Dakota," 1973, Part III.

† 1 cu. ft./sec (cfs) = 2 ac. ft./day = 730 ac. ft./year. 1 gal./min = .00223 cfs = 1.63 ac. ft./year.

‡ Show total mean annual concentration of all salts on line 4. List mean annual concentration of major salts on lines 4a, b, c, etc.

* If additional space is required, footnote under "Remarks"

TABLE A2-4

GPO 852 - 688

Form 1600–6
(August 1969)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

PHYSICAL PROFILE
HYDROLOGIC DATA

Unit	
Lower Tongue River Aquifer	Date 1968 By

ITEM	UNIT	ESTIMATED ANNUAL AMOUNT	SOURCE REFERENCE*
1. Water Yield †	gal/min	5 - 50	# 2
2. Water Use †	ac. ft.		# 1
3. Sediment Production	cu. yds.	NOT AVAILABLE	
4. Other Pollutants ‡	ppm		
a. TDS	ppm	1440-1930	# 2
b. Chloride	ppm	17 - 96	# 2
c. Fluoride	ppm	.9 - 1.8	# 2
d. Boron	ppm	.6 - .93	# 2
e. SAR	ppm	Very High	# 2

Remarks

1. Current and Potential Water Use; livestock, domestic and industrial.

2. M. G. Croft, US Geological Survey, "Ground Water Resources, Mercer and Oliver Counties, North Dakota," 1973, Part III.

† 1 cu. ft./sec (cfs) = 2 ac. ft. day = 730 ac. ft./year. 1 gal./min = .00223 cfs = 1.63 ac. ft./year.

‡ Show total mean annual concentration of all salts on line 4. List mean annual concentration of major salts on lines 4a, b, c, etc.

* If additional space is required, footnote under "Remarks"

TABLE A2-5

GPO 852 - 688

Form 1600-6
(August 1969)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

PHYSICAL PROFILE
HYDROLOGIC DATA

Unit Undifferentiated Lignite Aquifers in the Tongue River & Sentinel Butte Formation	Date 1968 By		
ITEM	UNIT	ESTIMATED ANNUAL AMOUNT	SOURCE REFERENCE*
1. Water Yield †	gal/min	10	
2. Water Use †	ac. ft.		# 1
3. Sediment Production	cu. yds.	NOT AVAILABLE	
4. Other Pollutants ‡	ppm		
a. SC	ppm	500-7000	# 2
b. TDS	ppm	1050-1810	# 2
c. Iron	ppm	3.6 - 3.3	# 2
d. Fluoride	ppm	.2 - .4	# 2
e.	ppm		

Remarks

1. Current and Potential Water Use; livestock and industrial.

2. M. G. Croft, US Geological Survey, "Ground Water Resources, Mercer and Oliver Counties, North Dakota," 1973. Part III.

† 1 cu. ft./sec (cfs) = 2 ac. ft./day = 730 ac. ft./year. 1 gal./min = .00223 cfs = 1.63 ac. ft./year.

‡ Show total mean annual concentration of all salts on line 4. List mean annual concentration of major salts on lines 4a, b, c, etc.

* If additional space is required, footnote under "Remarks"

TABLE A2-6

GPO 852 - 588

Cabba Series

These are shallow, very strongly sloping to very steep, well drained, loamy soils on residual uplands with thin sola. They are usually found on "breaks" along deeply cut streams.

In a representative profile the surface layer (plow depth) is a loam about 8 inches thick. It is grayish brown in the upper 2 inches and light brownish gray below. Beneath the surface layer is a friable, pale yellow loam about 8 inches thick. Below this is a stratified, light silty clay loam and soft loam bedrock. It is pale yellow to depths about 24 inches and pale olive below.

Nearly all of these soils are used, and best suited for range. They are also suitable for native hayland on stone and rock free areas where slopes are less than 15 percent. Steep slopes, susceptiblity to erosion, low available water capacity, and low fertility make these soils unsuitable for cultivation. Series Classification: Loamy, mixed (calcareous), frigid, shallow; Typic Ustorthent.

Mandan Series

These are deep, nearly level to sloping and rolling, well drained, loamy soils formed in calcareous loess. They are on the Missouri River terrace and within 2 miles of the terrace on adjacent uplands. The loess is about 40 inches to 8 feet thick, underlain by glacial till on uplands, and by stratified loamy material or sand and gravel on terraces.

In a representative profile the surface layer is a dark grayish brown silt about 19 inches thick. The very friable, grayish brown, silt loam subsoil is about 11 inches thick. The silt loam underlaying material is light brownish gray to depths of about 54 inches; grayish brown to depths of about 58 inches; and light yellowish brown below.

They are a prime source of sand and gravel for road base and surfacing. The aggregate has poor to fair suitability for concrete. Most of these soils are suited to all crops commonly grown in the county. The major crops are small grains, corn, and alfalfa. Series Classification: Coarse, silty, mixed; Pachic Haploboroll.

Regent Series

Regent soils have a very dark grayish brown, silty clay loam or silty clay A1 layer, 4 to 19 inches thick. Below this is a dark grayish brown to olive brown, silty clay B2t layer. Free lime occurs at depths of 10 to 20 inches in the lower B2t layer or in the olive brown or olive Cca layer. The C material is an olive or olive gray silty clay with occasional thin layers of silty clay loam. Small masses of white or pale yellow gypsum and/or other salt crystals often occur in the C material. In places, the C material grades into the original bedrock (layered clays or soft shales).

These soil areas consist of long slopes with uniform gradients which extend from low smoothly rounded knolls and small areas of nearly level tableland to swales and drainageways. The soils are on very old, layered, water-deposited clays and soft shales. Series Classification: Fair croplands, good pastureland, fine, montmorillonitic; Typic Argiboroll.

Ringling Series

These are shallow, strongly sloping to steep, excessively drained, loamy soils formed in scoria beds on uplands.

In a representative profile the surface layer is a dark reddish gray, channery loam about 7 inches thick. Beneath the surface layer is very friable, reddish brown, very channery loam about 8 inches thick. Below this is hard, reddish yellow, fractured scoria beds.

These soils are suited to permanent grass and are used for range. The underlying scoria beds have some value for road surfacing material, but can be pulverized by heavy traffic and eroded from the roadbeds. The major management concerns are low available water capacity and fertility. Series Classification: Fragmental, mixed; Typic Haploboroll.

Rhoades Series

In native grassland, Rhoades soils often have a very dark grayish brown, silt loam or loam A1 layer less than 2 inches thick. In places this layer is not present and the surface layer is the silt loam or loam A2 layer. The combined thickness of the A1 and A2 layers is usually less than 5 inches. The B2t layer is a very dark grayish brown, silty clay or silty clay loam. The dense columns of the B2t layer often are coated with very dark gray organic stains and streaked with light gray in the upper part. Free lime and large amounts of salt and/or gypsum crystals occur in the lower B2t layer. The C material consists of olive brown to olive gray and olive layers of silty clay, silty clay loam, and silt loam. Gypsum and other salt crystals occur in varying amounts throughout the C material. On upland slopes, the C material often grades into the original bedrock (layered silts, loams, clays, and soft shales).

Rhoades soils are usually found on gentle slopes which spread from the bases of hills, ridges, and higher uplands. These soils may also dominate broad upland drainageways and flats. The soils are on very old, layered clays, silts, loams, and soft shales deposited by water. Series Classification: Poor cropland, medium pastureland, fine, montmorillonitic; Leptic Natriboroll.

Temvik Series

These are deep, nearly level to rolling, well drained, loamy soils on thin loess-mantled, glacial till uplands and terraces. Temvik soils formed in a thin layer of loess and the underlying glacial till or loamy terrace material.

In a representative profile the surface layer is a dark grayish brown silt loam about 11 inches thick. The subsoil is about 21 inches thick. The upper 16 inches is a very friable, brown silt loam. The lower 5 inches is a friable, light yellowish brown, clay loam. The underlying material is light yellowish brown and light brownish gray, calcareous clay loam glacial till.

Most of these soils are well or fairly well suited to all crops commonly grown in the county. Small grains, alfalfa, and corn are the main crops. Series Classification: Fine-silty, mixed; Typic Haploboroll.

Wilton Series

These are deep, nearly level to gently undulating, well drained, loamy soils on thin, loess-mantled, glacial till uplands and terraces. Wilton soils are formed in a thin layer of loess and the underlying glacial till or loamy terrace material.

In a representative profile, the surface layer is a very dark grayish brown silt loam about 9 inches thick. The subsoil is about 22 inches thick. It is a very friable dark grayish brown silt loam in the upper part and a friable grayish brown clay loam in the lower part. The underlying material, to a depth of 60 inches, is a friable, clay loam glacial till. The upper part is lightly brownish gray and the lower part is light yellowish brown.

Most of these soils are well suited to all crops grown in the county. They are used mainly for small grains, alfalfa, and corn. Series Classification: fine-silty, mixed; Pachic Haploboroll.

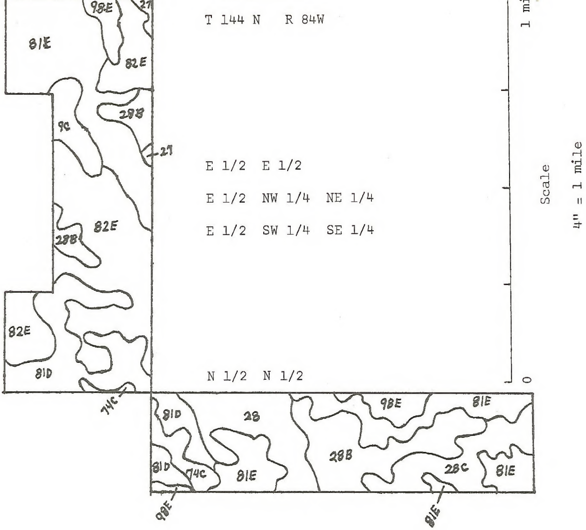
Williams Series

This series consists of deep, nearly level to steep, well drained, loamy soils on uplands. They are usually gently undulating and lie on convex and plane slopes. Surface drainage is normally well defined, but is poorly defined on some of the larger tracts. These soils formed in glacial till. Rounded cobbles, stones, and boulders are common on the surface or within the soils.

In a representative profile, the surface layer is a dark grayish brown loam about 7 inches thick. The friable clay loam subsoil is about

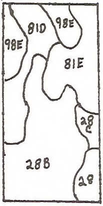
19 inches thick. The upper part is brown; the middle part grayish brown; and the lower part light yellowish brown. The clay loam underlying material is light gray to depths of about 30 inches and light yellowish brown below. It is a friable, calcareous, glacial till.

Most areas are suited to and used for cultivated crops, usually small grasses. Hilly, steep, and stony areas are used for pasture. Williams soils having slopes less than 9% are suited to all crops commonly grown in the county. Surface stones in some places make cultivation difficult, but are usually only a tillage nuisance. Series Classification: Fine-loamy, mixed; Typic Argiboroll.



Map Symbol	Map Unit and Slope	Acres	% of Area
9C	Regent silty clay loam, 6-9%	11.2	3
27	Mandan silt loam, 1-3%	4	1
28	Wilton silt loam, 1-3%	28.8	8
28B	Temvik-Williams silt loams, 3-6%	47.6	13
28C	Temvik-Williams silt loams, 6-9%	24.8	7
74C	Regent-Rhoades Complex, 6-9%	10.4	3
81D	Cabba Complex, 9-15%	46.4	13
81E	Cabba Complex, 15-35%	92.6	26
82E	Cabba-Badland Complex, 15-50%	79.8	22
98E	Ringling-Cabba Complex, 9-35%	14.4	4
		360.0	100.0

FIGURE A2-7



T 144 N R 84 W

W 1/2 SE 1/4

Scale

4" = 1 mile

Map Symbol	Map Unit and Slope	Acres	% of Area
28	Wilton silt loam, 1-3%	5.2	6.5
28B	Temvik-Williams silt loams, 3-6%	32.0	40.0
28C	Temvik-Williams silt loams, 6-9%	3.6	4.5
81D	Cabba Complex, 15-35%	13.2	16.5
81E	Cabba Complex, 15-50%	16.4	20.5
98E	Ringling-Cabba Complex, 9-35%	9.6	12
		80.0	100.0

FIGURE A2-7 continued

TABLE A2-7

SOIL CHARACTERISTICS AND PROPERTIES

MAP SYMBOL	MAP UNIT AND SLOPE	CAPABILITY CLASS	RANGE SITE	PARENT MATERIAL	LANDSCAPE POSITION	TEXTURE	EFFECTIVE ROOTING DEPTH	NATURAL DRAINAGE	PERM-EABILITY	AVAILABLE WATER CAPACITY	PH
9C	Regent silty clay loam 6-9%	IIIe	Clayey	Interbedded clayey and silty shales	Uplands	Silty clay loam to clay	39"	Well	Slow	Mod.	6.6 to 9.0
27	Mandan silt loam, 1-3%	IIe	Silty	Calcareous Loess	Nearly level uplands or terraces	Silt loam	60"	Well	Mod.	High	6.6 to 7.8
28	Wilton silt loam, 1-3%	IIc	Silty	Loess over glacial till	Glacial till uplands and terraces	Silt loam to clay loam	60"	Well	Mod. Slow	High	6.6 to 7.8
28B	Temvik-Williams silt loams, 3-6%	IIe	Silty	Loess over glacial till	Glacial till uplands and terraces	Silt loam to clay loam	60"	Well	Mod. Slow	High	6.6 to 7.8
28C	Temvik-Williams silt loams, 6-9%	IIIe	Silty	Loess over glacial till	Glacial till uplands and terraces	Silt loam to clay loam	60"	Well	Mod. Slow	High	6.6 to 7.8

TABLE A2-7 Cont.

SOIL CHARACTERISTICS AND PROPERTIES

MAP SYMBOL	MAP UNIT AND SLOPE	CAPABILITY CLASS	RANGE SITE	PARENT MATERIAL	LANDSCAPE POSITION	TEXTURE	EFFECTIVE ROOTING DEPTH	NATURAL DRAINAGE	PERM-EABILITY	AVAILABLE WATER CAPACITY	PH
74C	Regent-Rhoades Complex, 6-9%	IVe	Thin Claypan	Interbedded clayey and silty shales	Uplands	Silty clay loam to clay	4" to 39"	Well	Slow	Mod.	6.6 to 9.0
81D	Cabba Complex, 9-15%	VIe	Shallow	Interbedded loam, silt-stone and shale	"breaks" along deeply cut streams	Loam to silty clay loam	18"	Well	Mod.	Low	6.6 to 7.8
81E	Cabba Complex 15-35%	VIIe	Shallow	Interbedded loam, silt-stone and shale	"breaks" along deeply cut streams	Loam to silty clay loam	16"	Well	Mod.	Low	6.6 to 7.8
82E	Cabba-Badland Comples, 15-50%	VIIe	Shallow	Interbedded loam, silt-stone and shale	"breaks" along deeply cut streams	Loam to silty clay loam	16"	Well	Mod.	Low	6.6 to 7.8
98E	Ringling-Cabba Complex, 9-35%	VIIe	Shallow	Soft loam-stone over scoria	Scoria beds on uplands	Chan-nery loam to Sicl	15"	Well to Exc.	Mod.	Very Low	6.6 to 7.8

APPENDIX 2

SILTY RANGE SITE

1. TOPOGRAPHY

   a. This site occurs on nearly level to hilly terrain, and on high stream terraces. Slopes are commonly from one to 15 percent.

2. SOILS

   a. These are well drained, medium and moderately fine textured soils on residual and glacial till plains and terraces. Soils usually are deep, but some range in depth from 20 to 40 inches to siltstone or sandstone. Permeability is moderate to slow. Soil fertility is generally high and stored soil water is readily released to plants.

   b. Soil taxonomic units common to this site are:

      Amor loam
      Arnegard loam and silt loam
      Farland loam and silt loam
      Grassna silt loam
      Mandan silt loam
      Morton loam and silt loam
      Sen loam and silt loam
      Shambo loam
      Temvik silt loam
      Williams loam and clay loam

   Refer to Section II-A for a complete list of soil taxonomic units and range sites.

3. POTENTIAL VEGETATION

   a. Midgrasses dominate the general appearance of this site. Principal species are western wheatgrass, needle-and-thread, green needlegrass, and prairie junegrass. Other species are blue grama, Penn sedge, threadleaf sedge, needleleaf sedge, and red threeawn. About 10 percent by weight of the total production is forbs. Minor amounts of woody species may occur on this site. A detailed description of the vegetation in excellent condition is on the following page.

   b. With cattle-induced retrogression, principal decreaser species are green needlegrass, prairie junegrass, needle-and-thread, and porcupinegrass. Species that increase are western wheatgrass, blue grama, Penn sedge, threadleaf sedge, needleleaf sedge, and red threeawn.

With continued heavy grazing, blue grama, threadleaf and needleleaf sedges will dominate the site with varying amounts of fringed sage, green sagewort, gray sagewort, and other forbs.

c. Approximate total annual production of this site in excellent condition is from 1650 to 2250 pounds of air-dry herbage per acre, depending on growing conditions.

Relative Percent Composition of the Potential Vegetation

	Mean Productivity	
	lbs/acre	% Composition
Grasses		
Western wheatgrass	486	25
Needle-and-thread	292	15
Green needlegrass	195	10
Blue grama	272	15
Prairie junegrass	98	5
Porcupinegrass Bearded wheatgrass Red threeawn Sandberg bluegrass	98	5
Kentucky bluegrass Other grasses	98	5
Grass-likes		
Penn sedge Threadleaf sedge Needleleaf sedge	98	5
Forbs		
Heath aster Prairie coneflower Green sagewort Scarlet globemallow Purple prairieclover Hoods phlox Other forbs	195	10
Shrubs and Half-shrubs		
Prairie rose Western snowberry Silver sage Fringed sage Winterfat	98	5
Total	1950	100

3--Silty Range Site

4. DOMESTIC LIVESTOCK GRAZING VALUE

a. This site is highly suited for both cattle and sheep due to its diverse species composition of grasses, sedges, forbs, and shrubs. The best season of grazing is summer; however, the site also has spring, fall, and winter grazing value.

5. WILDLIFE NATIVE TO THE SITE

a. This site is utilized by deer and antelope; upland game birds such as the sharp-tailed grouse; smaller mammals such as the pocket gopher, coyote, and jackrabbit. In addition, several species of birds and waterfowl use the site, depending upon the presence or absence of trees and shrubs and sites with channels containing water. Open grasslands are used by birds such as the horned lark, lark bunting, meadowlark, and chestnut-collared longspur. Sites traversed by channels with trees and shrubs have species such as the red-winged blackbird, mourning dove, meadowlark, brown thrasher, and eastern kingbird. Sites traversed by channels with water are attracted by waterfowl such as the mallard, pintail, blue-winged teal, and shoveller; and small mammals like the raccoon and muskrat use this site.

6. ESTHETIC AND RELATED VALUES

a. The rolling grasslands common to this site give one the enjoyment of open space. Many colorful hues add variety to the site from the large array of flowering forbs throughout spring and summer. The site is adaptable for several recreational uses, such as hunting, hiking, horseback riding, and winter sports.

7. HYDROLOGIC CHARACTERISTICS

a. This site is common to most watersheds and is extensive in this vegetation zone. Runoff is slow to moderate on good to excellent condition, properly grazed range. Rate of water transmission is moderate for the soil profile.

8. A TYPICAL SITE LOCATION IN THIS AREA IS AS FOLLOWS

CLAYEY RANGE SITE

1. TOPOGRAPHY

   a. This site is on nearly level to rolling uplands. It also is on nearly level to sloping terraces of rivers and streams, and on sloping alluvial fans. Slope gradients range from one to 15 percent.

2. SOILS

   a. These are deep and moderately deep, well drained soils. Surface soils are moderate to fine textured. The subsoils and substratum are moderately fine or fine textured. Some soils are underlain by soft platy shale, or partly weathered siltstone or sandstone at depths of 30 inches or more. Permeability is moderately slow or slow. Available water capacity is low to high.

   b. Soil taxonomic units common to the site are:

      Belfield loam, silt loam, and silty clay loam
      Lawther silty clay
      Moreau clay, silty clay, and silty clay loam
      Regent clay loam, silty clay, and silty clay loam
      Savage silt loam and silty clay loam

   Refer to Section II-A for a complete list of soil taxonomic units and range sites.

3. POTENTIAL VEGETATION

   a. Vegetation is primarily a mixture of short and mid grasses, sedges, and forbs. Principal species are western wheatgrass, green needlegrass, and prairie junegrass. Other species are sandberg bluegrass, plains reedgrass, blue grama, and upland sedges. Common forbs are scarlet globemallow, prairie thermopsis, and western yarrow. Only minor amounts of woody species are present. A detailed description of the vegetation in excellent condition is on the following page.

   b. With continued heavy grazing by cattle, principal decreaser species are green needlegrass, prairie junegrass, needle-and-thread, and plains reedgrass. Species that increase are western wheatgrass, blue grama, upland sedges, and fringed sagewort. With further site deterioration blue grama, upland sedges, fringed sagewort, and unpalatable forbs will dominate the site.

c. Approximiate total annual production of this site in excellent condition is from 1550 to 2100 pounds of air-dry herbage per acre, depending on growing conditions.

Relative Percent Composition of the Potential Vegetation

	Mean Productivity	
	lbs/acre	% Composition
Grasses		
Western wheatgrass	720	40
Other wheatgrasses 1/	90	5
Green needlegrass	180	10
Prairie junegrass	90	5
Blue grama	180	10
Sandberg bluegrass Porcupinegrass Needle-and-thread	90	5
Plains reedgrass Kentucky bluegrass Other grasses	180	10
Grass-likes		
Penn sedge Needleaf sedge Other grass-likes	90	5
Forbs		
Scarlet globemallow Prairie thermopsis Western yarrow Prairie coneflower Prairie onion Large goatsbeard Other forbs	90	5
Shrubs and Half-shrubs		
Western snowberry Prairie rose Fringed sagewort Common winterfat Silver sagebrush Other shrubs	90	5
Total	1800	100

1/ Includes Montana, thickspike, and slender wheatgrasses.

3--Clayey Range Site

4. DOMESTIC LIVESTOCK GRAZING VALUE

a. This site is suitable for cattle and sheep grazing. The best season of grazing is summer. The site also has spring and fall grazing value. Clayey range sites grazed during the spring should be periodically deferred from grazing to maintain and/or improve the plant composition.

5. WILDLIFE NATIVE TO THE SITE

a. Upland birds such as the sharp-tailed grouse and mourning dove use this site for food and cover. Mule deer and white-tailed deer depend on this site for browse and other forage. Antelope also use the site. Small mammals such as the pocket gopher, jackrabbit, and coyote use the site. Upland songbirds such as the red-winged blackbird, meadowlark, lark bunting, and chestnut-collared longspur are common on clayey range site. Waterfowl such as the mallard and pintail use the site for nesting when shrubs are present and water is in the immediate area.

6. ESTHETIC AND RELATED VALUES

a. This range site is associated with the spacious rolling grassland prairies. Flowering forbs are primarily limited to early spring.

7. HYDROLOGIC CHARACTERISTICS

a. Runoff is slow or medium on excellent condition, properly used sites. Water transmission rate of the soils is slow and very slow.

8. A TYPICAL SITE LOCATION IN THIS AREA IS AS FOLLOWS

SHALLOW RANGE SITE

1. TOPOGRAPHY

   a. This site is on undulating to hilly areas, on crests of hills and ridges, side slopes on upland plains, and sides of valleys. A wide range of slopes are encountered and gradients range from three to 50 percent.

2. SOILS

   a. These soils are shallow, well and somewhat excessively drained. The most limiting factor to growth of vegetation is the low water storage capacity. Surface soils range from two to nine inches in thickness and are coarse to moderately fine textured. The parent material is a layer of sandstone, siltstone, or shale which is restrictive to root penetration. Permeability is moderate to rapid above the parent material.

   b. Soil taxonomic units common to the site are:

      Cabba loam, silt loam, and silty clay loam
      Cohagen fine sandy loam
      Flasher fine sandy loam, sandy loam, and loamy fine sand
      Werner loam

   Refer to Section II-A for a complete list of soil taxonomic units and range sites.

3. POTENTIAL VEGETATION

   a. A mixture of cool and warm season midgrasses dominate the general appearance of this site. Principal species are western wheatgrass, needle-and-thread, little bluestem, and prairie sandreed. Other species are plains muhly, blue grama, sideoats grama, threadleaf sedge, and Penn sedge. The percentage of wheatgrass is usually somewhat greater on loamy soils versus sandy soils and amount of prairie sandreed are greater on sandy soils versus loamy soils. About 10 percent of the total herbage production are forbs and woody plants are found in only small amount.

   A detailed description of the vegetation in excellent condition is as follows:

2--Shallow Range Site

Relative Percent Composition of the Potential Vegetation

	Mean Productivity	
	lbs/acre	% Composition
Grasses		
Little bluestem	350	25
Needle-and-thread	140	10
Western wheatgrass	70	5
Plains muhly	70	5
Blue grama	70	5
Sideoats grama	70	5
Prairie sandreed	140	10
Plains reedgrass Red threeawn Prairie junegrass Porcupinegrass	70	5
Other grasses	70	5
Grass-likes		
Penn sedge Threadleaf sedge	140	10
Forbs		
Black samson Hairy goldaster Skeletonweed Purple prairieclover Dotted gayfeather Stiff sunflower Green sagewort Other forbs	140	10
Shrubs and Half-shrubs		
Fringed sagewort Common winterfat Western snowberry Shrubby cinquefoil Other Shrubs	70	5
Total	1400	100

b. Continued heavy grazing by cattle results in a decrease of little bluestem, needle-and-thread, sideoats grama, and prairie sandreed. Species that increase are blue grama, western wheatgrass, red threeawn, and upland sedges. Further deterioration of the site results in a dominance of blue grama, upland sedges, unpalatable forbs, and fringed sagewort.

3--Shallow Range Site

c. Approximate total annual production of this site in excellent condition is from 1150 to 1650 pounds of air-dry herbage per acre, depending on growing conditions.

4. DOMESTIC LIVESTOCK GRAZING VALUE

a. This site is suitable for both cattle and sheep grazing. The best season of grazing is summer due to the large amount of warm-season grasses that are available. The site may also be used for fall grazing.

5. WILDLIFE NATIVE TO THE SITE

a. This site provides forage and cover for mule deer and white-tailed deer; is used by small mammals such as the skunk, badger, and red fox; upland birds such as the sharp-tailed grouse, mourning dove, chestnut-collared longspur, horned lark, and meadowlark. Several other songbirds, shorebirds, and birds of prey use the site particularly when it is adjacent to water and has shrubs available.

6. ESTHETIC AND RELATED VALUES

a. The varied topography and wide range of slopes encountered on this site offer the observer scenery and open space. Many colorful flowering plants bloom on the site throughout the spring and summer. Grasses, such as little bluestem, add a reddish-brown aspect to the site during the fall of the year.

7. HYDROLOGIC CHARACTERISTICS

a. This site is of large extent in western North Dakota. Runoff is medium to rapid on good and excellent condition, properly used range, depending upon gradients. Water transmission rate of the soil is high or moderate.

8. A TYPICAL SITE LOCATION IN THIS AREA IS AS FOLLOWS

THIN CLAYPAN RANGE SITE

1. TOPOGRAPHY

   a. This site occurs on nearly level to moderately sloping uplands and on stream terraces. Slopes are commonly from 0 to 9 percent.

2. SOILS

   a. These soils have thin surfaces underlain by hardpan. Subsoils contain high sodium accumulations. Permeability is very slow. Available water capacity is low. Areas of thin topsoil may be devoid of vegetation and appear as "slick spots".

   b. Soil Taxonomic units common to this site are:

      Rhoades fine sandy loam and silty clay

   Refer to Section II-A for a complete list of soil taxonomic units and range sites.

3. POTENTIAL VEGETATION

   a. Shortgrasses dominate the general appearance of this site. Principal species are western wheatgrass, blue grama, prairie junegrass, and Sandberg bluegrass. Other species are inland saltgrass, tumblegrass, buffalograss, Penn sedge, and other upland sedges. Forb species make up about five percent of the total production. Common woody plants are fringed sagebrush, broom snakeweed, and cactus species.

   b. With continued heavy grazing by cattle, grasses such as western wheatgrass, prairie junegrass, and needle-and-thread decrease. Species that increase are blue grama, inland saltgrass, Sandberg bluegrass, upland sedges, and fringed sagebrush. Continued site deterioration results in a dominance of shortgrasses, sedges, fringed sagebrush, broom snakeweed, and undesirable forbs.

   c. Approximate total annual production of this site in excellent condition if from 450 to 850 pounds of air-dry herbage per acre, depending on growing conditions. Percent of the ground that is covered by living or dead vegetation is about 60 to 85 percent.

   A detailed description of the vegetation in excellent condition is on the following page.

2--Thin Claypan Range Site

Relative Percent Composition of the Potential Vegetation

	Mean Productivity	
	lbs/acre	% Composition
Grasses		
Western wheatgrass	210	30
Blue grama	210	30
Prairie junegrass	35	5
Sandberg bluegrass	35	5
Buffalograss Inland saltgrass Tumblegrass Other wheatgrasses Needle-and-thread	35	5
Other grasses	35	5
Grass-likes		
Penn sedge Needleleaf sedge	35	5
Forbs		
Rush skeletonplant Scarlet globemallow Mousear chickweed Other forbs	35	5
Shrubs and half-shrubs		
Fringed sagebrush	35	5
Broom snakeweed Ball cactus Sagebrush species	35	5
Total	700	100

4. DOMESTIC LIVESTOCK GRAZING VALUE

a. This site has a very low stocking rate potential. Plant cover is easily destroyed on this site by overuse and recovery is slow. The best season of use is fall in order to maintain good plant cover. Cattle are more suitable than sheep due to lack of species diversity and sparseness of stand.

5. WILDLIFE NATIVE TO THE SITE

a. This site provides some forage for the white-tailed deer, mule deer, and antelope. It is used by small mammals such as the jackrabbit, striped skunk, prairie dog, and fox. Several upland songbirds use this site, such as the lark bunting, horned lark, chestnut-collared longspur, and goldfinch.

3--Thin Claypan Range Sites

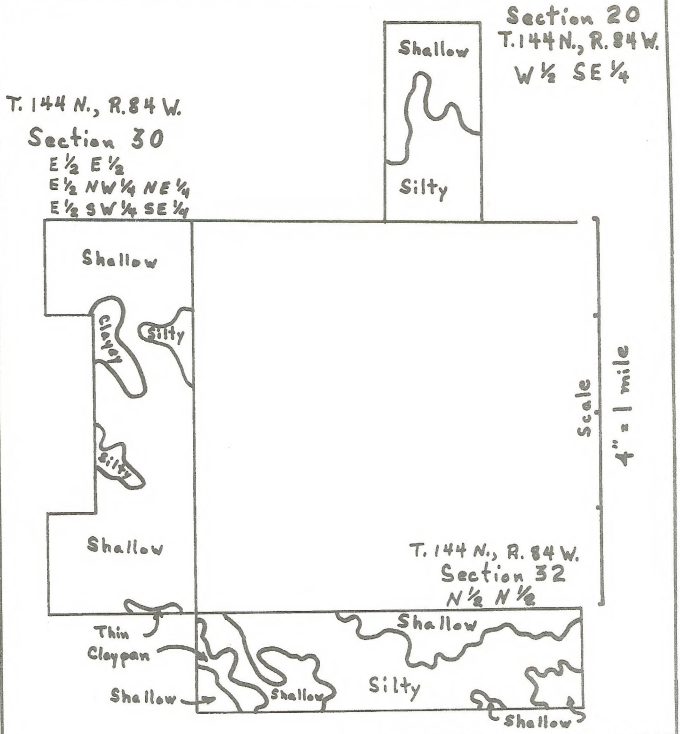
6. ESTHETIC AND RELATED VALUES

a. The esthetic values of this range site are commonly enhanced by the surrounding and/or intermingled sites that offer more plant variety. This site is usually in complex with other range sites. Certain species of wildlife such as the prairie dog and burrowing owl are attracted to this site for its sparse cover.

7. HYDROLOGIC CHARACTERISTICS

a. Runoff is slow to medium on good and excellent condition, properly grazed range. Water transmission rate of the soil is very slow.

8. A TYPICAL LOCATION IN THIS AREA IS AS FOLLOWS



Range Site	Acres	% of Area
Silty	146.0	33
Clayey	11.2	3
Shallow	272.4	62
Thin Claypan	10.4	2
Total	440.0	100

U. S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Glenharold Coal Mine Range Sites

DESIGNED ____	RECOMM. ____
DRAWN DAR	RECOMM. ____ CHIEF, DIV. OF ENG.
CHECKED ____	APPROVED ____
SCALE 4" = 1 mile	
DATE 4-22-76	SHEET 1 OF 1
DRAWING NO.	

FIGURE A2-8

☆ GPO 853-660

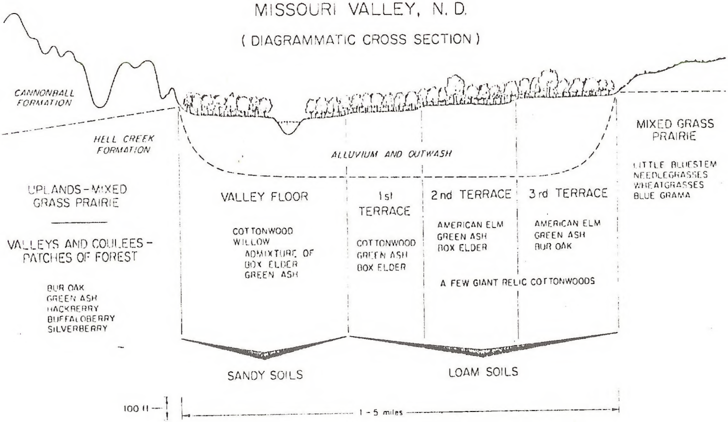


FIGURE A2-9

Diagrammatic cross section of the study area portion of the Missouri Valley in North Dakota, showing the general distribution of vegetation and the surface and sub-surface geology. (From Burgess, et.al., 1973).

APPENDIX 2

PLANT SPECIES PRESENT IN THE AREA OF THE PROPOSED COAL GASIFICATION FACILITY SITE IN MERCER COUNTY, NORTH DAKOTA

Common Name	Scientific Name[1]	Longevity[2]	Origin[3]	Life Form[4]	Response to Grazing[5]	Comments
Absinth	Artemisia absinthium	P	I	F	I	Half-shrub
Alfalfa	Medicago sativa	P	I	F	-	Cultivated legume
Alumroot	Heuchera richardsonii	P	N	F	-	--
Anemone, Canada	Anemone canadonsis	P	N	F	-	--
Arrowgrass	Triglochin maritima	P	N	F	-	--
Arrowhead	Saggitaria cureata	P	N	F	-	Emergent aquatic
Artichoke, Jerusalum	Helianthus tuberosus	P	N	F	-	--
Ash, green	Fraxinus pennsylvanica	-	N	W	-	Tree
Aspen, quaking	Populus tremuloides	-	N	W	-	Tree
Aster, aromatic	Aster oblongifolius	P	N	F	-	
Aster, golden	Chrysopsis villosa	P	N	F	I	--
Aster, rush	Aster junciformis	P	N	F	-	--
Aster, tall white	Aster coerulescens	P	N	F	-	--
Aster, white prairie	Aster ericoides	P	N	F	-	--
Aster, white upland	Aster ptarmicoides	P	N	F	-	--
Barley	Hordeum vulgare	A	-	G	-	Crop species
Barley, wild	Hordeum jubatum	P	N	G	IV	Mid-grass
Bearberry	Arctostaphylos uva-ursi	-	N	W	-	Trailing shrub
Beardtongue, slender	Penstemon gracilis	P	N	F	D	--
Beardtongue, white	Penstemon albidius	P	N	F	D	--
Bedstraw, northern	Galium boreale	P	N	F	-	--
Bergamont, wild	Monarda fistulosa	P	N	F	D	--
Bindweed, field	Convolvulus arvensis	P	I	F	-	--
Bluebell	Campanula rotundifolia	P	N	F	-	--
Bluegrass, fowl	Poa palustris	P	N	G	IV	Mid-grass

TABLE A2-8 continued

Common Name	Scientific Name[1]	Longevity[2]	Origin[3]	Life Form[4]	Response to Grazing[5]	Comments
Bluegrass, Kentucky	Poa pratensis	P	I	G	IV	Mid-grass
Bluegrass, plains	Poa arida	P	N	G	D	Mid-grass
Bluegrass, swallen	Poa glaucifolia	P	N	G	D	Mid-grass
Bluegrass, Sandberg	Poa secunda	P	N	G	I	Short-grass
Bluestem, big	Andropogon gerardi	P	N	G	D	Tall-grass
Bluestem, little	Andropogon scoparius	P	N	G	D	Mid-grass
Boneset, false	Kuhnia eupatorioides	P	N	F	-	--
Box-elder	Acer negundo	-	N	W	-	Tree
Breadroot, indian	Psoralea esculenta	P	N	F	D	Legume
Brome, smooth	Bromis inermis	P	I	G	IV	Hay grass
Broomweed	Gutierrezia sarothrae	P	N	F	I	Half-shrub
Buckwheat, wild	Polygonum convolvulus	A	N	F	IV	--
Buffaloberry	Shepherdia argentea	-	N	W	-	High shrub
Buffalograss	Buchloe dactyloides	P	N	G	I	Short-grass
Bulrush, hardstem	Scirpus acutus	P	N	S	D	Emergent aquatic
Bulrush, prairie	Scirpus paludosus	P	N	S	D	--
Bulrush, river	Scirpus fluviatilis	P	N	S	D	Emergent aquatic
Bulrush, softstem	Scirpus validus	P	N	S	D	Emergent aquatic
Burningbush	Kochia scoparia	A	N	F	IV	--
Burreed	Sparganium eurycarpum	P	N	-	-	Emergent aquatic
Buttercup, marsh	Ranunculus septentrionalis	P	N	F	-	--
Cacti	Mamilaria sp. and Opuntia sp.	P	N	-	I	--
Candelabra, fairy	Androsace occidentalis	A	N	F	-	--
Caragana	Caragana arborescens	-	I	W	-	High shrub
Carrion-flower	Smilax herbacea	P	N	F	-	--
Catsfoot	Antennaria sp.	P	N	F	I	--
Cattail, broad-leaved	Typha latifolia	P	N	-	-	Emergent aquatic
Cattail, narrow-leaved	Typha angustifolia	P	N	-	-	Emergent aquatic
Cedar, creeping	Juniperus horizontalis	-	N	W	-	Trailing shrub
Cherry, choke	Prunus virginiana	-	N	W	-	High shrub

Common Name	Scientific Name[1]	Longevity[2]	Origin[3]	Life Form[4]	Response to Grazing[5]	Comments
Cherry, ground	Physalis lanceolata	P	N	F	-	--
Cherry, Nanking	Prunus tomentosa	-	I	W	-	Tree
Cherry, sand	Prunus pumila	-	N	W	-	Low shrub
Chickweed, prairie	Cerastium arvense	P	N	F	-	--
Cinquefoil, Pennsylvania	Potentilla pennsylvanica	P	N	F	-	--
Cinquefoil, rough	Potentilla norvegica	B	N	F	IV	--
Cinquefoil, silverweed	Potentilla anserina	P	N	F	I	--
Cinquefoil, tall	Potentilla arguta	P	N	F	-	--
Clover, owl	Orthocarpus luteus	A	N	F	-	--
Clover, purple prairie	Petalostemum purpureum	P	N	F	D	Legume
Clover, sweet	Melilotus sp.	B	I	F	-	Cultivated legume
Collomia	Collomia linearis	A	N	F	IV	--
Coneflower, long-headed	Ratibida columnifera	P	N	F	IV	--
Coneflower, purple	Brauneria angustifolia	P	N	F	D	--
Cordgrass, alkali	Spartina gracillis	P	N	G	D	Mid-grass
Cordgrass, prairie	Spartina pectinata	P	N	G	D	Tall-grass
Corn	Zea mays	A	-	G	-	Crop species
Cottonwood	Populus deltoides	-	N	W	-	Tree
Crab, Siberian	Malus baccata	-	I	W	-	Tree
Creeper, Virginia	Parthenocissus inserta	-	N	W	-	Vine
Currant, golden	Ribes odoratum	-	N	W	-	Low shrub
Currant, wild black	Ribes amererricanum	-	N	W	-	Low shrub
Dock, curled	Rumex crispus	P	I	F	-	--
Dock, golden	Rumex persicarioides	B	N	F	-	--
Dock, willow-leaved	Rumex mexicanus	P	N	F	I	--
Dogbane, spreading	Apocynum androsaemifolium	P	N	F	-	--
Dropseed, prairie	Sporobolus heterolepis	P	N	G	D	Mid-grass
Dropseed, sand	Sporobolus cryptandrus	P	N	G	I	Mid-grass
Dropseed, tall	Sporobolus asper	P	N	G	D	Mid-grass
Elder, marsh	Ira xanthifolia	A	N	F	IV	--

Common Name	Scientific Name[1]	Longevity[2]	Origin[3]	Life Form[4]	Response to Grazing[5]	Comments
Elm, American	Ulmus americana	-	N	W	-	Tree
Elm, Chinese	Ulmus parvifolia	-	I	W	-	Tree
Elm, Siberian	Ulmus pumila	-	I	W	-	Tree
Eriogonum, yellow	Eriogonum flavum	P	N	F	-	Half-shrub
Fescue, six-weeks	Festuca octoflora	A	N	G	IV	Short-grass
Flax, common	Linum usitatissimum	A	-	F	-	Crop species
Flax, Lewis' wild	Linum leuisii	P	N	F	D	--
Flax, stiffstem	Linum rigidum	A	N	F	IV	--
Fleabane, daisy	Erigeron sp.	-	N	F	-	--
Frenchweed	Thlaspi arvense	A	N	F	IV	--
Gaura	Gaura coccinea	P	N	F	-	--
Goatsbeard, large	Tragopogon dubius	B	N	F	-	--
Goldenrod, early	Solidago missouriensis	P	N	F	-	--
Goldenrod, giant	Solidago gigantea	P	N	F	-	--
Goldenrod, soft	Solidago mollis	P	N	F	D	--
Goldenrod, stiff	Solidago rigida	P	N	F	I	--
Goldenrod, tall	Solidago altissima	P	N	F	-	--
Gooseberry, Missouri	Ribes missouriense	-	N	W	-	Low shrub
Grama, blue	Bouteloua gracilis	P	N	G	I	Short-grass
Grama, side-oats	Bouteloua curtependula	P	N	G	D	Mid-grass
Grass, indian	Sorghastrum nutans	P	N	G	D	Tall-grass
Porcupine, porcupine	Stipa spartea	P	N	G	D	Tall-grass
Grass, western porcupine	Stipa spartea (var.)	P	N	G	D	Mid-grass
Gumweed	Grindelia squarrosa	B	N	F	IV	--
Hawthorn, round-leaved	Crataegus rotundifolia	-	N	W	-	High-shrub
Hemp, indian	Apocynum sibiricum	P	N	F	-	--
Honeysuckle	Lonicera sp.	-	I	W	-	High shrub
Horsetail, Kansas	Equisetum kansanum	-	N	-	-	Spore-bearing
Indigo, dwarf wild	Amorpha nana	-	N	W	-	Low shrub
Ironweed, cut-leaved	Aplopappus spinulosus	P	N	F	I	--

Common Name	Scientific Name[1]	Longevity[2]	Origin[3]	Life Form[4]	Response to Grazing[5]	Comments
Ivy, poison	Rhus radicans	-	N	W	-	Low shrub
Juneberry	Amelanchier alnifolta	-	N	W	-	High shrub
Junegrass, prairie	Koeleria cristata	P	N	G	D	Mid-grass
Juniper, Rocky Mountain	Juniperus scopulorum	-	N	W	-	High shrub
Juniper, trailing	Juniperus horizontalis	-	N	W	-	Trailing shrub
Kinghead	Ambrosia trifida	A	N	F	-	--
Knotweed	Polygonum sp.	A	N	F	-	--
Lamb's-quarter	Chenopolium album	A	N	F	IV	--
Leadplant	Amorpha canescens	-	N	W	D	Low shrub, legume
Lettuce, blue wild	Lactuca pulchella	P	N	F	D	--
Lettuce, prickly	Lactuca serriola	A	N	F	D	--
Licorice, wild	Glycyrrhiza lepidota	P	N	F	-	Legume
Lilac	Syringa vulgaris	-	I	W	-	High shrub
Loco, purple	Oxytropes lambertii	P	N	F	I	Legume
Lupine, false	Thermopsis rhombifolia	P	N	F	I	Legume
Mallow, red	Sphaeralcea coccinea	P	N	F	I	--
Mannagrass, American	Glyceria grandis	P	N	G	D	Tall-grass
Meadowgrass, salt	Puccinellia nuttalliana	P	N	G	D	Mid-grass
Milkvetch, striate	Astragalus striatus	P	N	F	-	Legume
Milkvetch, tufted	Astragalus triphyllus	P	N	F	-	Legume
Milkweed, common	Asclepias syriaca	P	N	F	-	--
Milkweed, whorled	Asclopias verticillata	P	N	F	I	--
Milkwort, white	Polgala alba	P	N	F	D	--
Mint, wild	Mentha arvensis	P	N	F	-	--
Muhly, marsh	Muhlenbergia racemosa	P	N	G	D	Mid-grass
Muhly, mat	Muhlenbergia richardsonis	P	N	G	I	Short-grass
Muhly, plains	Muhlenbergia cuspidata	P	N	G	D	Short-grass
Mustard, tansy	Descurainia sp.	A	N	F	IV	--
Needle-and-thread	Stipa comata	P	N	G	I	Mid-grass
Needlegrass, green	Stipa viridula	P	N	G	D	Mid-grass

TABLE A2-8 continued

Common Name	Scientific Name[1]	Longevity[2]	Origin[3]	Life Form[4]	Response to Grazing[5]	Comments
Oats	Avena sativa	-	-	-	-	Crop species
Oats, spike	Avena hookeri	P	N	G	-	Mid-grass
Oats, wild	Avena fatua	A	I	G	-	--
Olive, Russian	Euonymus angustifolta	-	I	W	-	High shrub
Onion, white wild	Allium textile	P	N	F	-	--
Osier, red	Cornus stolonifera	-	N	W	-	High shrub
Panicum, Wilcox	Panicum wilcoxianum	P	N	G	D	Short-grass
Parsley, wild	Musineon divaricatum	P	N	F	-	--
Parsnip, meadow	Zizia aptera	P	N	F	-	--
Parsnip, water	Sium suave	P	N	F	-	--
Pasque-flower	Anemone patens	P	N	F	-	--
Pennyroyal, rough	Hedeoma hispida	A	N	F	IV	--
Peppergrass	Lepidium densiflorum	A	N	F	IV	--
Phlox, moss	Phlox hoodii	P	N	F	I	--
Pine, ponderosa	Pinus ponderosa	-	N	W	-	Tree
Plantain, alkalai	Plantago eriopoda	P	N	F	I	--
Plantain, Pursh's	Plantago purshii	A	N	F	IV	--
Plantain, water	Alisma subcordalum	P	N	F	-	Emergent aquatic
Plum, ground	Astragalus caryocarpus	P	N	F	-	Legume
Plum wild	Prunus americana	-	N	W	-	High shrub
Pondweed, sago	Potamogeton pectinatus	-	N	-	-	Submerged aquatic
Poverty weed	Iva axillaria	P	N	F	-	--
Pricklypear, brittle	Opuntia fragilis	P	N	-	I	--
Pricklypear	Opuntia polycantha	P	N	-	I	--
Primrose, tooth-leaved	Oenothera serrulata	P	N	F	-	Half shrub
Quackgrass	Agropyron repens	P	I	G	IV	Mid-grass
Rabbitbrush	Chrysothamnus graveolens	-	N	W	I	Low shrub
Ragweed perennial	Ambrosia coronapifolia	P	N	F	I	--
Redtop	Agrostis alba	P	I	G	IV	Mid-grass
Reed-canarygrass	Phalaris arundinacea	P	N	G	D	Tall-grass

TABLE A2-8 continued

Common Name	Scientific Name[1]	Longevity[2]	Origin[3]	Life Form[4]	Response to Grazing[5]	Comments
Reedgrass, northern	*Calamagrostris inexpansa*	P	N	G	D	Mid-grass
Reedgrass, plains	*Calamagrostris montanensis*	P	N	G	D	Short-grass
Rivergrass	*Scolochloa festucacea*	P	I	G	D	Tall-grass
Rockcress, Holboell	*Arabis holboellii*	-	N	F	-	--
Rose, prairie wild	*Rosa arkansana*	-	N	W	I	Low shrub
Rose, western wild	*Rosa woodsii*	-	N	W	I	Low shrub
Rush, Baltic	*Juncus balticus*	P	N	-	IV	--
Sage, fringed	*Artemisia frigida*	P	N	F	I	Half-shrub
Sage, green	*Artemisia glauca*	P	N	F	I	--
Sage, white	*Artemisia ludoviciana*	P	N	F	-	--
Sagebrush, silver	*Artemisia cana*	-	N	W	I	Low shrub
Saltbush, hastate	*Atriplex hastata*	P	N	F	-	--
Saltgrass	*Distichlis stricta*	P	N	G	I	Short-grass
Sandgrass, big	*Calamovilfa longifolia*	P	N	G	D	Tall-grass
Scratchgrass	*Muhlenbergia asperifolia*	P	N	G	I	Short-grass
Seablite	*Suaeda depressa*	A	N	F	IV	--
Sedge, fescue	*Carex brevior*	P	N	S	D	--
Sedge, long-beaked	*Carex sprengelii*	P	N	S	-	--
Sedge, needleaf	*Carex elescharis*	P	N	S	I	--
Sedge, Pennsylvania	*Carex pennsylvanica*	P	N	S	I	--
Sedge, Sartwell	*Carex sartwellii*	P	N	S	-	--
Sedge, slim	*Carex praegraciles*	P	N	S	I	--
Sedge, slough	*Carex atherodes*	P	N	S	D	--
Sedge, smoothcone	*Carex laeviconica*	P	N	S	-	--
Sedge, threadleaf	*Carex filifolia*	P	N	S	I	--
Sedge, wooly	*Carex lanuginosa*	P	N	S	D	--
Silverberry	*Elaeagnus argentia*	-	N	W	I	Low shrub
Silverleaf	*Psoralia argophylla*	P	N	F	-	Legume
Skeletonweed	*Lygodesmia juncea*	P	N	F	I	--
Skunkbush	*Rhus trilobata*	-	N	W	-	Low shrub

Common Name	Scientific Name[1]	Longevity[2]	Origin[3]	Life Form[4]	Response to Grazing[5]	Comments
Sloughgrass, American	Beckmannia syzigachne	A	N	G	IV	Mid-grass
Smartweed, long-rooted	Polygonum coccineum	P	N	F	-	--
Sorrel, upright yellow-wood	Oxalis stricta	A	N	F	IV	--
Sowthistle, spiny	Sonchus asper	A	N	F	-	--
Spikemoss	Selaginella densa	-	-	-	-	Spore bearing
Spikerush, common	Eleochris palustris	P	N	S	I	--
Spikerush, needle	Eleochris acicularis	P	N	S	I	--
Spurge	Euphorbia sp.	-	N	F	-	--
Star, evening	Mentzelia decapetala	B	N	F	-	--
Star, narrow-leaved blazing	Liatris punctata	P	N	F	D	--
Stickseed	Hackelia americana	B	N	F	-	--
Sunflower, common	Helianthus annuus	A	N	F	IV	--
Sunflower, narrow-leaved	Helianthus maximiliani	P	N	F	D	--
Sunflower, Rydberg's	Helianthus rydbergii	P	N	F	D	--
Sunflower, stiff	Helianthus regidus	P	N	F	D	--
Switchgrass	Panicum virgatum	P	N	G	D	Tall-grass
Threeawn, red	Aristida longiseta	P	N	G	I	Short-grass
Thistle, bull	Cirsium vulgare	B	N	F	IV	--
Thistle, prairie	Cirsium undulatum	P	N	F	I	--
Ticklegrass	Agrostis scabra	P	N	G	IV	Short-grass
Toadflax, bastard	Commandra pallida	P	N	F	-	--
Trefoil, prairie brids'-foot	Lotus americanus	A	N	F	IV	Legume
Tumblegrass	Schedonnardus paniculatus	P	N	G	IV	Short-grass
Vervain, swamp	Verbena hostata	P	N	F	-	--
Vetch, American	Vicia americana	P	N	F	D	Legume

Common Name	Scientific Name[1]	Longevity[2]	Origin[3]	Life Form[4]	Response to Grazing[5]	Comments
Vetch, prairie	Vicia sparsifolia	P	N	F	D	Legume
Wallflower, western	Erysimum asperum	B	N	F	-	--
Wedgegrass, prairie	Sphenopholis obtusata	P	N	G	D	Mid-grass
Wheat	Triticum aestivum	A	-	G	-	Crop species
Wheatgrass, bearded	Agropyron subsecundum	P	N	G	D	Mid-grass
Wheatgrass, creasted	Agropyron cristatum	P	I	G	-	Hay grass
Wheatgrass, Montana	Agropyron albican	P	N	G	D	Mid-grass
Wheatgrass, slender	Agropyron trachycaulum	P	N	G	D	Mid-grass
Wheatgrass, thickspike	Agropyron dasystachyum	P	N	G	D	Mid-grass
Wheatgrass, western	Agropyron smithii	P	N	G	D	Mid-grass
Whitlowwort	Paronychia sessiliflora	P	N	F	-	--
Wild-rye, Canada	Elymus canadensis	P	N	G	D	Tall-grass
Wild-rye, Macoun	Elymus macounii	P	N	G	D	Mid-grass
Wild-rye, Virginia	Elymus virginius	P	N	G	D	Mid-grass
Willow, golden	Salix alba Var. vitellina	-	I	W	-	Tree
Willow, heart-leaved	Salix cordata	-	N	W	-	High shrub
Willow, laurel-leaved	Salix pentandra	-	I	W	-	Tree
Willow, Missouri	Salix missouriensis	-	N	W	-	High shrub
Willow, peach-leaved	Salix amygdaloidis	-	N	W	-	Tree
Willow, pussy	Salix discolor	-	N	W	-	High shrub
Willow, sandbar	Salix interior	-	N	W	-	High shrub
Winterfat	Eurotia lanata	P	N	F	-	Half-shrub
Wolfberry	Symphoricarpos occidentalis	-	N	W	-	Low shrub
Yarrow	Achillea lanulosa	P	N	F	I	--

[1] According to Stevens (1963)

[2] A - Annual, B - Biennial, P - Perennial

[3] N - Native, I - Introduced

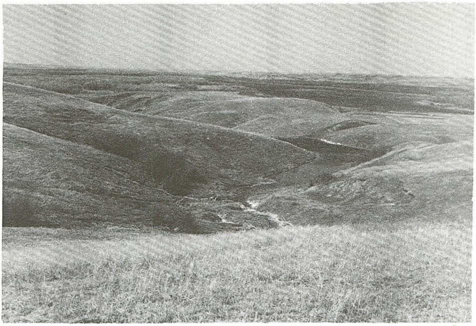
TABLE A2-8 continued

[4]G - Grass, S - Sedge (Grass-like), F - Forb, W - Woody

[5]I - Increaser, D - Decreaser, IV - Invader; according to U.S.D.A. Soil Conservation Service, 1957 (Unpublished).

Compiled by: Woodward-Envicon, Inc., 1974.

Adapted directly from "Environmental Impact Report - North Dakota Gasification Project for ANG Coal Gasification Company" by Woodward-Clyde Consultants dated 1975.



Stockwater pond (reservoir) in a coulee (foreground) and Missouri River (background). Consol-Glenharold Coal Mine-Stanton, North Dakota. T. 144 N., R. 84 W., Section 20, NW¼SE¼. 4/6/76. Viewed looking north.

Stockwater pond surrounded by woody vegetation. Consol-Glenharold Coal Mine-Stanton, North Dakota. T. 144 N., R. 84 W., Section 32, N½NW¼. 4/6/76. Viewed looking west.

APPENDIX 2

ANIMALS

The list of animals that follows includes all species which are known to exist or could be expected to exist in Mercer-Oliver Counties as permanent residents, migrants, or occasional residents. Some species exist in the two counties in very small numbers because their required habitat in the counties is marginal or is of small quantity. The riparian habitat along the Missouri River makes up only a small proportion of the total land area of the two counties; however, it provides a greater diversity of habitat and therefore allows a greater diversity of species.

Where applicable, the following selected status designations are listed alongside the common and scientific names of the species.

N - Birds species that are the most common nesting species in the management area.

I - Animal species that have been introduced and are not native.

S - Fish species that are stocked from fish hatcheries, may or may not be native.

G - Animal species that are taken for sport, fur, or flesh.

P - Animal species which cause significant damage to man, his crops, his livestock, or his property.

E - Endangered animal species - those animal species that are threatened with extinction, as determined by either Federal or State officials.

U - Status - undetermined - Animal species that have been suggested to be threatened with extermination, but there is not enough information to determine its status.

R - "Rough" fish species which are taken for commercial sale from Lake Sakakawea.

M - Occurs in the area principally when in migration.

Fish

	Status Designation
Pallid sturgeon (*Scaphirhynchus albus*)	U
Shovelnose sturgeon (*Scaphirhynchus platorynchus*)	
Paddle fish (*Polyodon spathula*)	R
Shortnose gar (*Lepisosteus platostomus*)	
Gizzard shad (*Dorosoma cepedianum*)	
Brown Trout (*Salmo trutta*)	G, I, S
Rainbow trout (*Salmo gairdner*)	G, I, S
Coho Salmon (*Oncorhynchus kisutch*)	G, I, S
Goldeye (*Hiodon alosoides*)	R
Northern pike (*Esox lucius*)	G, S
Brassy minnow (*Hybognathus kankinsoni*)	
Silvery minnow (*Hybognathus nuchalis*)	
Plains minnow (*Hybognathus placitus*)	
Hornyhead chub (*Hybopsis biguttatta*)	
Flathead chub (*Hybopsis gracilis*)	
Lake chub (*Hybopsis plumbea*)	
Golden shiner (*Notemigonus crysoleucas*)	
Emerald shiner (*Notropis antheriniodes*)	
Common shiner (*Notropis cornutus*)	
Bigmouth shiner (*Notropis dorsalis*)	
Plains shiner (*Notropis percobromus*)	
Red shiner (*Notropis lutrensis*)	
Sand shiner (*Notropis stramineus*)	

	Status Designation
Fathead minnow (<u>Pimephales promelas</u>)	
Creek chub (<u>Semotilus atromaculatus</u>)	
Longnose dace (<u>Rhinichthys cataractae</u>)	
River carpsucker (<u>Carpiodes carpio</u>)	R
White sucker (<u>Catostomus commersoni</u>)	R
Northern redhorse (<u>Moxostoma macrolephidotum</u>)	
Longnose sucker (<u>Catostomus catostomus</u>)	
Blue sucker (<u>Cycleptus elongatus</u>)	
Smallmouth buffalo (<u>Ictiobus balalus</u>)	R
Bigmouth buffalo (<u>Ictoibus cyprinellus</u>)	R
Carp (<u>Cyprinus carpio</u>)	I, R
Black bullhead (<u>Ictalurus melas</u>)	G
Brown bullhead (<u>Ictalurus nebulosus</u>)	G
Channel catfish (<u>Ictalurus punctatus</u>)	G
Blue catfish (<u>Ictalurus furcatus</u>)	G
Flathead catfish (<u>Pilodictis olivaris</u>)	G
Tadpole madtom (<u>Noturus gyrinus</u>)	
Stonecat (<u>Noturus flavus</u>)	
White bass (<u>Roccus chrysops</u>)	G
Rockbass (<u>Ambloplites rutestris</u>)	G
Pumpkinseed (<u>Lepomis gibbosus</u>)	G
Orangespotted sunfish (<u>Lepomis humilis</u>)	
Bluegill (<u>Lepomis machrochirus</u>)	G
Longear sunfish (<u>Lepomis megalotis</u>)	
White crappie (<u>Pomoxis annularis</u>)	G

	Status Designation
Black crappie (Promoxis nigromaculatus)	G
Largemouth bass (Micropterus salmoides)	G
Iowa darter (Etheostoma exile)	
Johnny darter (Etheostoma nigrum)	
Yellow perch (Perca flavescens)	G, I, S
Sauger (Stizostedion canadense)	G
Walleye (Stizostedion vitreum vitreum)	S, G
Freshwater drum (Aplodinotus grunniens)	R
Burbot (Lota lota)	

Adapted directly from "Oliver-Mercer URA - Step II Physical Profile" by S. Montgomery dated 1975.

APPENDIX 2

AMPHIBIANS AND REPTILES PROBABLY OCCURRING IN NORTH DAKOTA WEST OF THE MISSOURI RIVER WITH REFERENCE TO HABITAT PREFERENCE

Class and Species		Habitats[1] Aquatic	Woodlands	Grasslands
Amphibia				
Blotched tiger salamander	*Ambystoma tigrinum melanostictum*		X	X
Plains spadefoot	*Scaphiopus bombifrons*			X
Rocky Mountain toad	*Bufo w. woodhousei*			X
Great Plains toad	*Bufo congnatus*			
Boreal chorus toad	*Pseudacris nigrita septentrionalis*		X	X
Northern leopard frog	*Rana p. pipens*		X	X
Reptilia				
Common snapping turtle	*Chelydra serpentina*		X	X
Western painted turtle	*Chrysemys picta belli*		X	X
Western spiny softshell	*Trionyx spinifer hartwegi*	X		
Smooth soft-shelled turtle	*Trionyx muticus*	X		
Sagebrush lizard	*Sceloporus graciosus*			X
Shorthorned lizard	*Phrynosoma douglassei brevirostre*			X
Western plains garter snake	*Thamophis radix haydeni*			X
Red-sided garter snake	*Thamophis sirtalis parietalis*			X
Plains hognose snake	*Heterodon nasicus nasicus*			X
Eastern yellow-bellied racer	*Coluber constrictor flaviventris*		X	X

TABLE A2-10

TABLE A2-10 continued

Class and Species		Habitats[1] Aquatic	Woodlands	Grasslands
Western smooth green snake	_Opheodrys vernalis blanchardi_			X
Bullsnake	_Pituophis melanoleucus sayi_			X
Prairie rattlesnake	_Crotalus v. viridus_			X

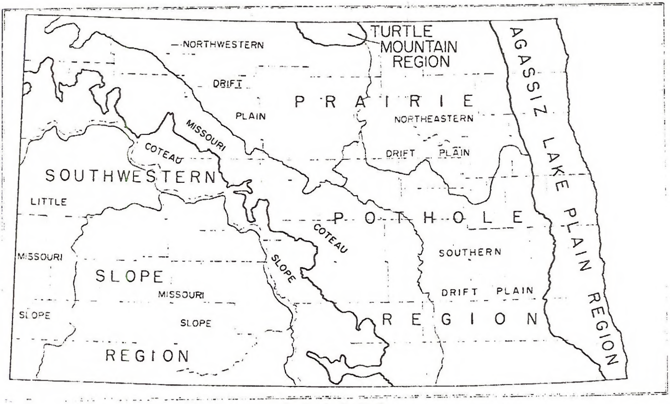
[1] Wheeler and Wheeler, 1966

Sources: Conant, 1958; Wheeler and Wheeler, 1966

Adapted directly from "Environmental Impact Report. North Dakota Gassification Project for ANG Coal Gasification Company" by Woodward - Clyde Consultants dated 1975.

APPENDIX 2

Biotic areas of North Dakota.



Adapted directly from "Breeding Birds of North Dakota" by Robert E. Stewart dated 1975. Tri-College Center for Environmental Studies. Fargo, North Dakota.

FIGURE A2-10

APPENDIX 2

FAUNISTIC COMPOSITION OF BREEDING BIRDS

Adapted directly from "Breeding Birds of North Dakota"
by Robert E. Stewart dated 1975.
Tri-College Center for Environmental Studies.
Fargo, North Dakota

The breeding birds of North Dakota are composed of four distinct faunistic elements. Each of these elements represents a group of species that show similar biogeographical relationships. One primary group, referred to as the North-central Avifauna, includes typical species of the northern prairie region on the central plains that are of paramount importance throughout the state. The other groups, of secondary importance, are restricted to somewhat limited populations that are of local occurrence wherever appropriate habitat conditions are found. These, referred to as the Eastern, Western, and Northern Avifaunas, include species that are best represented in major biotic regions, or biomes, outside of the state boundaries.

North-Central Avifauna

The typical species occupy various upland and wetland habitats that represent natural successional stages leading to and including the climax mixed-grass prairie associations. A total of 56 species of birds are representative. These include seven species largely endemic within the northern mixed-grass prairie regions--the Marbled Godwit, Sprague's Pipit, Lark Bunting, Baird's Sparrow, Le Conte's Sparrow, Clay-colored Sparrow, and Chestnut-collared Longspur--and 49 pandemic species. The species in the latter group also are of regular occurrence in other major biotic regions.

Characteristic Species

- Eared Grebe
- Western Grebe
- Pied-billed Grebe
- White Pelican
- Trumpeter Swan
- Canada Goose
- Gadwall
- Mallard
- Pintail
- Blue-winged Teal
- Northern Shoveler
- Canvasback
- Redhead
- Ruddy Duck
- Ferruginous Hawk
- Marsh Hawk
- Sharp-tailed Grouse
- Whooping Crane
- Sandhill Crane
- Sora
- American Coot
- Piping Plover
- Killdeer
- Upland Plover
- Willet
- Marbled Godwit
- American Avocet
- Wilson's Phalarope
- Franklin's Gull
- Double-crested Cormorant
- American Bittern
- Black-crowned Night Heron
- Forster's Tern
- Black Tern
- Burrowing Owl
- Short-eared Owl
- Common Nighthawk
- Horned Lark
- Bank Swallow
- Long-billed Marsh Wren
- Sprague's Pipit
- Common Yellowthroat
- Bobolink
- Western Meadowlark
- Red-winged Blackbird
- Yellow-headed Blackbird
- Brown-headed Cowbird
- Lark Bunting
- Savannah Sparrow
- Baird's Sparrow
- Grasshopper Sparrow
- Le Conte's Sparrow
- Sharp-tailed Sparrow
- Vesper Sparrow
- Clay-colored Sparrow
- Chestnut-collared Longspur

Eastern Avifauna

Species that typify this group are represented by considerable populations in various habitats within the eastern half of the state but occur more sparingly in the western half. Many of these 71 species are especially conspicuous in woodland biotic communities located on floodplains and bluffs along major streams, on prominent hills and escarpments, and as concentric bands that adjoin the shores of permanent lakes. Man-created woodland habitats including tree-claims, shelterbelts, and residential areas of towns and farmsteads are commonly utilized as well. Some of these species are also characteristic of other avifaunas.

Characteristic Species

Least Bittern
Green Heron
Great Blue Heron
Wood Duck
Cooper's Hawk
Red-tailed Hawk
Bald Eagle
American Kestrel 1/
Greater Prairie Chicken
Virginia Rail
Least Tern
Mourning Dove 1/
Passenger Pigeon
Black-billed Cuckoo
Screech Owl
Great Horned Owl
Barred Owl
Long-eared Owl
Whip-poor-will
Chimney Swift
Ruby-throated Hummingbird
Belted Kingfisher
Downy Woodpecker
Hairy Woodpecker
Red-headed Woodpecker
Yellow-shafted Flicker
Pileated Woodpecker
Eastern Kingbird
Great Crested Flycatcher
Eastern Phoebe
Willow Flycatcher
Least Flycatcher
Eastern Wood Pewee
Purple Martin
Rough-winged Swallow
Barn Swallow
Blue Jay
Common Crow
Black-capped Chickadee
White-breasted Nuthatch
House Wren
Short-billed Marsh Wren
Brown Thrasher
Gray Catbird
American Robin
Veery
Eastern Bluebird
Cedar Waxwing
Loggerhead Shrike 1/
Yellow-throated Vireo
Red-eyed Vireo
Warbling Vireo
Black-and-white Warbler
Yellow Warbler
Chestnut-sided Warbler
American Redstart
Ovenbird
Common Grackle
Baltimore Oriole
Orchard Oriole
Scarlet Tanager
American Goldfinch
Dickcissel
Cardinal
Rose-breasted Grosbeak
Indigo Bunting
Eastern Rufous-sided Towhee
Lark Sparrow 1/
Chipping Sparrow 1/
Field Sparrow 1/
Song Sparrow

1/ Species also characteristic of Western Avifauna.

Western Avifauna

This group involves 37 species that are quite prominent in the southwestern quarter of North Dakota and are represented by fairly large, local populations in the northwestern quarter. The breeding ranges of a few species also extend into the eastern half of the state. Most species occupy the habitat complexes of the western badlands but also occur in various types of woodland communities and in xerophytic tracts of the northern shrub desert.

Characteristic Species

Turkey Vulture
Sharp-shinned Hawk
Prairie Falcon
Peregrine Falcon
Merlin
American Kestrel 2/
Sage Grouse
Mountain Plover
Long-billed Curlew
California Gull
Mourning Dove 2/
Poor-will
Red-shafted Flicker
Western Kingbird
Say's Phoebe
Western Wood Pewee
Cliff Swallow
Black-billed Magpie
Rock Wren
Swainson's Hawk
Golden Eagle
Common Raven
Mountain Bluebird
Loggerhead Shrike 2/
Bell's Vireo
Audubon's Warbler
Yellow-breasted Chat
Brewer's Blackbird
Bullock's Oriole
Black-headed Grosbeak
Lazuli Bunting
Spotted Rufous-sided Towhee
Lark Sparrow 2/
Chipping Sparrow 2/
Brewer's Sparrow
Field Sparrow 2/
McCown's Longspur

2/ Species also characteristic of Eastern Avifauna.

BIOGEOGRAPHICAL DISTRIBUTION OF BREEDING BIRDS

In North Dakota, four biotic regions are recognized. These are referred to as the Agassiz Lake Plain Region, the Prairie Pothole Region, the Southwestern Slope Region, and the Turtle Mountain Region. Each region is distinguished primarily on the basis of major proportional differences in prominence of floristic and faunistic groups of species. On the basis of secondary differences in biotic relationships and on differences in prevalence of habitats, the Prairie Pothole Region and the Southwestern Slope Region are subdivided into biotic subregions.

Birds of the Southwestern Slope Region

This region covers about 38.5 percent of the total state area. Its' topographic features and biogeographical relationships show much more definite western affinities than are indicated by the other major biotic regions. In contrast to the adjoining Prairie Pothole Region, various portions of the Southwestern Slope Region are either unglaciated or only slightly to moderately affected by past glaciation. The region also is distinctive in that the surface drainage systems are well integrated throughout. On the basis of noticeable variations in topography and on secondary differences in biogeographical relationships, the Southwestern Slope Region has been subdivided into three subregions that are designated as the Coteau Slope, Missouri Slope, and Little Missouri Slope.

The gently sloping terrain of the Coteau Slope has been slightly to moderately affected by past glaciation. Sheet moraine and shallow ground moraine deposits are the principal glacial landforms throughout. Small areas of dead-ice moraine, end moraine, outwash plain and lake plain also occur. Drift-free, water-eroded exposures of sedimentary bedrock are quite common along bluff escarpments of stream valleys. Relief is generally low to medium except near such exposures, where typical badland topography is apparent. Other formations occur along the Missouri River Trench where dissected valley walls and broad bottom-land alluvial deposits have developed. Locally, a few scattered, shallow, natural basin wetlands are present on the gently sloping uplands.

The Missouri Slope is largely unaffected by glaciation, being entirely unglaciated in the western portion, while in the eastern half only a few small scattered remnants of sheet moraine are indicative of past glaciation. The broad, rolling uplands of this subregion are interrupted by bedrock valleys along many of the larger streams and by a few scattered high buttes. Locally, along the Cannonball and Heart rivers, small areas of badlands also have developed.

Within the Little Missouri Slope the wide, rugged badlands along the Little Missouri River and its tributaries represent the most prominent topographic feature. These picturesque formations are adjoined by broad, rolling uplands that contain many conspicuous high buttes. In the southern portion of the subregion, particularly in western Bowman County, other formations caused by shallow, surface erosion closely resemble the bleak "scablands" of eastern Washington.

The climax biotic community in the Southwestern Slope Region is represented by the western mixed-grass prairie association. This community could be described as an ecotone between the eastern mixed-grass prairie and typical short-grass prairie. Large expanses, usually grazed by livestock, are still present, although the total acreage is steadily being reduced in many areas because of the encroachment and expansion of vast areas of cropland. In this region, wheat is the principal agricultural crop.

Other more localized grassland communities also are fairly important in this region. In many lowland areas that occur in draws or near intermittent streams, typical eastern mixed-grass prairie is the prevalent type. Sizable tracts of short-grass prairie often are present on the more elevated uplands, especially within the Little Missouri Slope. In the southern portion of the Little Missouri Slope, an xerophytic grassland community, referred to as "black sage prairie", also is quite common.

A "badlands community complex" that may be described as a mosaic mixture of grassland, brushland, and sparsely vegetated eroded slopes is especially characteristic of all badland areas and often is quite extensive. Other natural habitats of local importance include thickets of small trees and shrubs in upland prairie draws, bands of floodplain forest along the larger streams, and scattered small tracts of western coniferous forest that are largely restricted to the southern half of the Little Missouri badlands. Certain wooded or partially wooded habitats created by man also have an appreciable influence on wildlife. These include shelterbelts, farmsteads, and residential areas in towns and cities. Wetland habitats, of limited importance in this region, include fluviatile wetlands, stock ponds, dugouts, and reservoirs.

In general, the breeding birds are dominated by upland species of the North-central Avifauna in association with many species of the Western Avifauna. Species characteristic of the Eastern Avifauna are fairly prominent locally, particularly in woodland habitats along permanent streams. Also, a few species of the Northern Avifauna are of rare occurrence in this region.

The characteristic breeding birds include 8 primary species, 28 secondary species, and 93 tertiary species. The primary and secondary species are listed as follows:

Primary Species

Sharp-tailed Grouse
Mourning Dove
Horned Lark
Western Meadowlark
Brown-headed Cowbird
Lark Bunting
Grasshopper Sparrow
Chestnut-collared Longspur

Secondary Species
(including well-marked subspecies)

Mallard
Pintail
Marsh Hawk
American Kestrel (local)
Ring-necked Pheasant
Gray Partridge
Killdeer
Common Nighthawk
Yellow-shafted Flicker (local)
Eastern Kingbird
Barn Swallow
Cliff Swallow
Black-billed Magpie
House Wren
Brown Thrasher
American Robin
Loggerhead Shrike (local)
Yellow Warbler
House Sparrow
Red-winged Blackbird
American Goldfinch
Dickcissel (local)
Lazuli Bunting (local)
Spotted Rufous-sided Towhee
Vesper Sparrow
Lark Sparrow
Clay-colored Sparrow
Field Sparrow

APPENDIX 2

MAMMALS PROBABLY OCCURRING IN NORTH DAKOTA
WEST OF THE MISSOURI RIVER

Family and Species[2]	
Soricidae	
Arctic shrew	*Sorex articus*
Masked shrew	*Sorex cinereus haydeni*
Merriam shrew	*Sorex m. merriami*
Shorttail shrew	*Blarina b. brevicauda*
Verpertilionidae	
Little brown bat	*Myotis lucifugus carissima*
Small footed myotis	*Myotis s. subulatus*
Keen myotis	*Myotis keeni septentrionalis*
Long-eared bat	*Myotis e. evotis*
Silver-haired bat	*Lasionycteris noctivagans*
Big brown bat	*Eptesicus f. fuscus*
Red bat	*Lasiurus b. borealis*
Hoary bat	*Lasiurus c. cinereus*
Procyonidae	
Raccoon	*Procyon lotor hirtus*
Mustelidae	
Least weasel	*Mustela r. rixosa*
Longtail weasel	*Mustela frenata longicauda*
Mink	*Mustela vison letifera*
Black-footed ferret[3]	*Mustela nigripes*
Wolverine	*Gulo l. luscus*
River otter	*Lutra c. canadensis*
Badger	*Taxidea t. taxus*
Spotted skunk	*Spilogale putorius*
Striped skunk	*Mephitis m. hudsonica*
Canidae	
Coyote	*Canis l. latrans*
Gray wolf	*Canis lupus nubilus*
Red fox	*Vulpes fulva regalis*
Swift fox[4]	*Vulpes velox hebes*

Family and Species	
Felidae	
Bobcat	*Lynx rufus pallescens*
Sciuridae	
Blacktail prairie dog	*Cynomys l. ludovicianus*
Richardson ground squirrel	*Spermophilus r. richardsonii*
Thirteen-lined ground squirrel	*Spermophilus tridecemlineatus pallidus*
Franklin ground squirrel	*Spermophilus franklinii*
Least chipmunk	*Eutamias minimus pallidus*
Eastern gray squirrel	*Sciurus carolensis hypophaeus*
Eastern fox squirrel	*Sciurus niger rufiventer*
Geomyidae	
Northern pocket gopher	*Thomomys talpoides rufescens*
Heteromyidae	
Wyoming pocket mouse	*Perognathus f. fasciatus*
Plains pocket mouse	*Perognathus flavescens perniger*
Hispid pocket mouse	*Perognathus hispidus paradoxus*
Ord kangaroo rat	*Dipodomys ordii terrasus*
Castoridae	
Beaver	*Castor canadensis missouriensis*
Cricetidae	
Western harvest mouse	*Reithrodontomys megalotis dychei*
Deer mouse[5]	*Peromyscus maniculatus*
White-footed mouse	*Peromyscus leucopus aridulus*
Northern grasshopper mouse[6]	*Onychomys leucogaster*
Bushytail woodrat	*Neotoma cinerea rupicola*
Boreal redback vole	*Clethrionomys gapperi loringi*
Meadow vole	*Microtus pennsylvanicus insperatus*

Family and Species	
Prairie vole	Microtus ochrogaster haydenii
Pale mouse	Microtus pallidus
Sagebrush vole	Lagurus curtatus pallidus
Muskrat	Ondatra zibethica cinnamonius
Muridae	
Norway rat	Rattus norvegicus
House rat	Mus musculus
Zapodidae	
Meadow jumping vole	Zapus hudsonius intermedius
Erethizontidae	
Porcupine	Erethizon dorsatum bruneri
Leporidae	
Whitetail jackrabbit	Lepus townsendi campanius
Eastern cottontail	Sylvilagus floridanus similis
Mountain cottontail	Sylvilagus nuttallii
Desert cottontail	Sylvilagus audobonii baileyi
Cervidae	
Whitetail deer	Odocoileus virginianus dacotensis
Mule deer	Odocoileus h. hemionus
Antilocapridae	
Pronghorn	Antilocapra a. americana

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[1]Common and scientific names according to Hall and Kelson, 1959.

[2]Some species noted at the subspecies level.

[3]Threatened; According to the U. S. Department of the Interior, 1973.

[4]Rare; According to the U. S. Department of the Interior, 1973.

[5] Includes two subspecies; osgoodi and nebrascensis

[6] Includes two subspecies; leucogaster and missouriensis

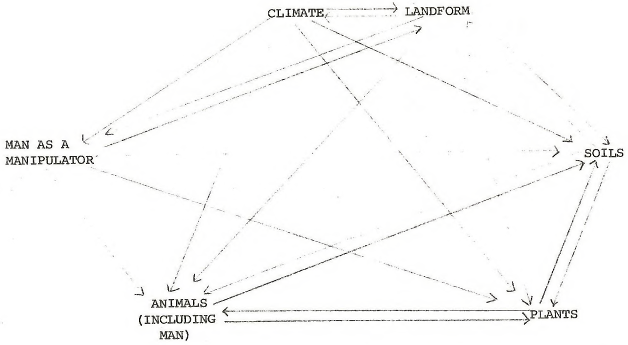
Sources: Burt and Grossenheider, 1964; Bailey, 1926; and Hall and Kelson, 1959.

Compiled by: Woodward-Envicon, Inc. 1974.

Adapted directly from "Environmental Impact Report - North Dakota Gasification Project for ANG Coal Gasification Company" by Woodward-Clyde Consultants dated 1975.

TABLE A2-11 continued

FIGURE A2-11



Each ecological land unit (ELU) has a relationship between living and non-living components. Each component is influenced to some degree by the others.

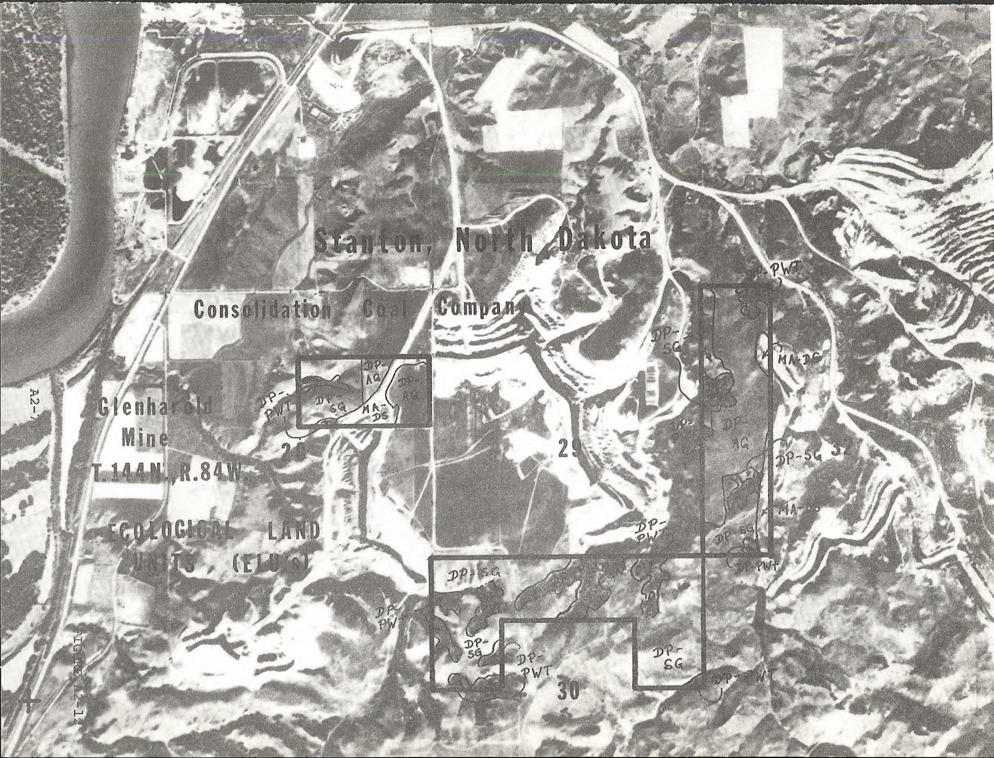
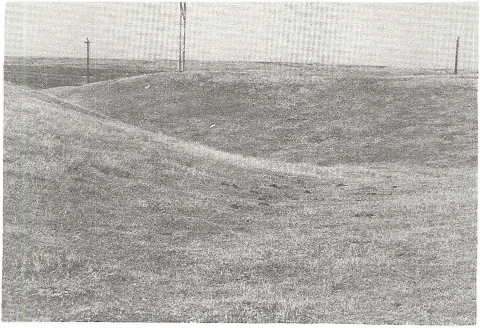

Stanton, North Dakota
Consolidation Coal Company
Glenharold Mine
T.144N.,R.84W.
ECOLOGICAL LAND UNITS (ELU's)
29
30
DP-PWT
DP-SG
DP-AG
MA-DS
DP-PW
DP-SG 32

FIGURE A2-12

The Dissected Plateau - Prairie Woodland Thicket and Dissected Plateau - Steppe Grassland ELU's on the Glenharold Mine Area. Stanton, North Dakota. T. 144 N., R. 84 W., Section 30, E½SE¼. 4/6/76. Viewed looking south.

The Dissected Plateau - Prairie Woodland Thicket and Dissected Plateau - Steppe Grassland (mowed) ELU's on the Glenharold Mine Area. Stanton, North Dakota. T. 144 N., R. 84 W., Section 32, N½NW¼. 4/6/76. Viewed looking northwest.



The Dissected Plateau - Steppe Grassland (native) ELU at the Glenharold Mine. Missouri River bottom in background. Stanton, North Dakota. T. 144 N., R. 84 W., Section 20, SW¼SE¼. 4/6/76. Viewed looking northeast.

The Dissected Plateau - Steppe Grassland ELU (background) and Dissected Plateau - Agricultural Land (retired) ELU (foreground) at the Glenharold Mine. Stanton, North Dakota. T. 144 N., R. 84 W., Section 20, W½SE¼. 4/6/76. Viewed looking north.

The Dissected Plateau - Agricultural Land (Flax field) ELU (foreground) and the Mined Area - Disturbed Site ELU (background) at the Glenharold Mine. Stanton, North Dakota. T. 144 N., R. 84 W., Section 32, N½NE¼. 4/6/76. Viewed looking southwest.

The Mined Area - Disturbed Site ELU at the Glenharold Mine. Stanton, North Dakota. Regrading and topsoiling the spoil banks. T. 144 N., R. 84 W., Section 29, SW¼. 4/6/76. Viewed looking northwest.

APPENDIX 2

Diversity Index

Diversity, simply defined, is the quality, or state, or "being different," or "varied." Diversity of habitats in an ecosystem is generally a desirable characteristic since a wide variety of habitats provides a wide variety of "niches," and a wide variety of "niches" supports a diversified floral and faunal community. For any single species, an optimum mixture of habitat components also exists. Leopold (1933) related to habitat diversity in terms of "edge-effect" in his Law of Interspersion for game populations. He stated, "The potential density of game of low radius requiring two or more types is, within ordinary limits, proportional to the sum of the type peripheries."

Patton (1975) developed a quantitative expression of Leopold's Law of Interspersion. Since the geometric figure with the greatest area and the least perimeter, or "edge," is a circle, Patton established the ratio of circumference to area of a circle as a given index value of one. He then derived a formula to compute a comparable index for any area to collate with a circle. Any index value larger than one is a measure of irregularity and can be used a a diversity index (DI). Patton's formula to set the ratio equal to one is:

$$\frac{C}{2\sqrt{A \cdot \pi}} = 1$$

where C is the circumference, A is the area, and π is 3.1416. The next step is to restate the formula for habitat diversity as:

$$DI = \frac{TP}{2\sqrt{A \cdot \pi}}$$

where TP is the total perimeter around the area plus any linear edge within the area.

The ELU's of the Glenharold Mine area (Appendix 2, Page A2-71) were utilized to develop a diversity index for the entire proposed lease tracts. Linear distance around the tracts and each ELU were determined with a map measurer. The calculations were as follows:

Entire Proposed Coal Lease Tracts -

$$DI = \frac{87{,}867 \text{ ft}}{2\sqrt{(43560 \text{ ft}^2/\text{acre})\ (480 \text{ acres})\ (3.1416)}}$$

$$= 5.42 \text{ (4 ELU's) (480 acres)}$$

This calculation indicates that, in terms of ELU's, the proposed coal lease tracts are 5.42 times more diverse (contains more "edge") than a circle. This diversity index provides insight to evaluating the environmental intricacy of mining coal on these lease tracts, as well as providing a basis for assigning relative impact ratings. It also alludes to the complexity of assuring adequate reclamation following coal mining.

APPENDIX 2

ARCHAEOLOGICAL-HISTORICAL SUMMARY

Lying on the west edge of the Missouri trench, the lease application lands are near many significant archaeologic sites (see Appendix 2, Figure A2-13). These sites have provided part of the data necessary for archaeologists to reconstruct the changing life-ways of American Indians in the Middle Missouri subarea.

The cultures of this subarea are often described by <u>periods</u>, during which certain cultural traits were dominant. For example, during the Paleo-Indian Period of the Middle Missouri and surrounding regions, the cultural hallmark was a complex of traits relating to the hunting of big game. The most diagnostic of these traits are a group of projectile points (spear heads) called Clovis, Folsom, and Plano. Other traits common to the period include sites where large animals were killed and slaughtered; artifact assemblages which indicate the processing of game; and some indicators of plant use such as grinding tools. The Paleo-Indian Period existed roughly between 11,000 B.C. and 6000 B.C. (Lehmer, 1971).

A projectile point which may date to the Paleo-Indian Period was found at the Medicine Crow Site north of the White River in South Dakota. This single artifact is scant evidence of man's presence in the Middle Missouri valley during the period. However, the geologic history of the Dakotas may explain why so little has been found of man's activities during the first few thousand years following the end of the last ice age. When the last great ice sheet receded from the region, many valleys were cut into the landscape, perhaps destroying much of the evidence for Paleo-Indian occupation of the Missouri River valley (Ibid.)

There are also few known sites in the Middle Missouri valley which appear to date between 6000 and 500 B.C., the Forager Period. In the Missouri River's Big Bend of South Dakota, some sites have yielded projectile points of the McKean Complex, which are typical of this period. However, the Missouri trench is on the eastern edge of the Northwestern Plains subarea, where most of the Forager sites have been located (Ibid.).

The traits which characterize the Forager Period include smaller, more crudely made projectile points than were present in Paleo-Indian times; milling stones, which indicate increased reliance on plant food; and new techniques for taking game. Like those who preceded them, the people of the Forager Period were organized into small nomadic bands whose only means of travel was by foot.

Related to the Woodland cultures of the eastern United States, cultures of the Plains Woodland Period introduced new traits to the area between 500 B.C. and 1 A.D. Pottery was made for the first time on the Plains during this period. Although evidence for corn growing in the Middle Missouri at this time is rare, the Woodland cultures probably practiced horticulture in addition to using the plants and game of the wooded bottom lands, and bison from the adjacent plains. Woodland sites contain a few shells from the Pacific Coast and Gulf Coast, indicating that trade was practiced (Ibid.). Mound building was another cultural trait introduced by peoples of this period. Although the reasons these earth mounds were built are still unknown, some of them were cemeteries, indicating elaborate religious or ceremonial practices (Wood and Johnson, 1973).

There are a number of Plains Woodland sites in the Middle Missouri subarea. One of these, the High Butte Site, is located only a few miles north of the Glenharold Mine. Earth mounds are known to exist within ½ mile of the lease application lands (Ibid.).

Between 900 and 1000 A.D., the Woodland complexes were replaced by cultures of the Plains Village Period. At this time, traits included villages constructed of post and pole framed, earth covered houses which were fairly permanent dwellings; pottery of various styles; and implements for agriculture such as the scapula (shoulder blade) hoe used to cultivate corn, beans, and squash (Lehmer, 1971).

The earliest of these village people probably came from south-western Minnesota, moving into the Missouri Valley in South Dakota after 900 A.D. A similar group settled to the north after 1100 A.D. The Buchfink site, near the Glenharold Mine, was once occupied by people of this second group. Migrating from the Missouri Valley of Nebraska and Kansas, a third culture of village dwellers settled below the initial South Dakota Villages. These people entered the area about 1400 A.D. Finally, between 1550 and 1675 A.D., there was a mixing of traits among these cultures until they became almost identical (Ibid.).

These village groups did not exist side by side without conflict The presence of fortified villages near the contact zones of these various groups, indicates that warfare may have been common. Even after there were no recognizable differences in material culture, it is likely that conflict persisted among the villages (Ibid.)

Near the Glenharold Mine and the town of Stanton, the remains of Lower Hidatsa Village and White Buffalo Robe Village represent the period from 1550 to 1675. Lower Hidatsa was occupied until about 1780.

During the 17th century, Plains Village culture began changing under the influence of Europeans in North America. The French began a system of fur trade along the St. Lawrence River which used Indians as middlemen. While traders remained at posts near Quebec, Indians used the goods obtained from the posts to barter for furs farther west. Pelts were then brought to the traders and exchanged for the white man's guns, blankets, and tools. The British Hudson's Bay Company joined in this trade network, establishing posts near James Bay and Hudson's Bay.

In the decade before 1650, the Iroquois Indians began a war to establish themselves as the primary middlemen in this fur trade. The Hurons had gotten wealthy in the trade, so the Iroquois made a move to take the mainstream of the business away from the French and British and give it to the Dutch in the Hudson Valley.

These Iroquois wars disrupted the old pattern in which the traders did not go into the interior. The French, followed by the British, began to move inland along the waterways and tap new fur markets with other Indians after 1650. Thus, a new pattern of trade was established with different groups of Indians becoming the middlemen (Ibid.).

A Frenchman, Pierre Gaultier de Varennes, Sieur de la Verendrye made the first well documented white contact with the Missouri village groups. In 1738, he noted a well established trade pattern in which these Indians were middlemen. The villagers of the Mandan and Hidatsa Tribes in North Dakota received trade goods from Hudson's Bay posts in Canada through the Cree and Assiniboine Indians, while the Arikara villages of the South Dakota Missouri Valley received trade goods through the Sioux. Northern and eastern groups, like the Assiniboine and Sioux, got trade goods from posts in Canada and the Western Great Lakes region to barter with the village peoples for their horticultural products and for goods obtained by the villagers from Indians west of the Missouri. From the Crow, Cheyenne, and other western groups, who had aquired horses in the first half of the 18th Century, the village people obtained leather goods, meat, and horses for guns and other items. The villagers then traded horses to the eastern Indians for more European goods.

The Missouri Valley villagers enjoyed the prosperity of being middlemen in the trade network until about 1780. Big Hidatsa Village, Lower Hidatsa Village, and Amahami Village near the lease application lands were occupied during the prosperous period, 1675 to 1780.

The last quarter of the 18th Century marked the beginning of a gradual decline in the population and prosperity of the Middle Missouri village Indians. An epidemic disease, perhaps smallpox, severely reduced their number in 1780-81. At the same time, the Sioux began a hostile westward expansion as they were pressured by other groups to the east. The villagers, weakened by disease, were forced to abandon many areas of the Missouri Valley and congregate for defense.

Adding to the decline of Plains village culture was the expansion of forts and posts by organized trading establishments. When the Lewis and Clark Expedition ventured through the Missouri Valley of the Dakotas from 1804-1806, most of the Europeans in the area were tenant traders. The tenant traders lived in Indian villages rather than posts and operated as small scale middlemen. Charbonneau was such a trader when he joined Lewis and Clark at Fort Mandan, near Stanton (Mattison, 1955). There were also a few men who represented organized trade and some independent or free-traders who occupied the Indian villages temporarily to exchange fair amounts of trade goods for furs. After the Lewis and Clark Expedition was completed in 1806, the organized traders expanded their posts into the Middle Missouri and beyond. They carried their trade directly to the migratory hunters of the Northwestern Plains. Thus, the village Indians lost their role as brokers in the trade system, a factor which contributed to the decline of the Mandan, Hidatsa, and Arikara (Lehmer, 1971).

Several sites near the Glenharold Mine represent Indian occupation and early European activity after 1780. The men of the Lewis and Clark Expedition built Fort Mandan as quarters for the winter of 1804-1805. The Missouri River channel now covers the site of the fort about three miles east of the mine. While camped in this area, these explorers visited the nearby Hidatsa villages of Amahami, Big Hidatsa Village, and Sacagawea. The Mandan villages of Black Cat and Deapolis were also occupied. Within a few miles of the mine, several of Lewis and Clark's temporary campsites have been located from descriptions in their journals.

Fort Clark, an American Fur Company post established by James Kipp in 1831, was located on the west bank of the Missouri about three miles from the mine. Kipp was representing the Columbia Fur Company when he established Fort Tilton in 1823, three miles north of the Fort Clark site.

These posts were constructed during the height of the fur trade on the Northwestern Plains. Shortly after the Lewis and Clark Expedition, the Missouri Fur Company tried to establish posts in the Middle Missouri. But this American firm had difficulties, and with the War of 1812, the expansion of fur trade was delayed until after the second decade of the 19th Century. The new Columbia Fur Company attempted to build in the area in 1823. J. J. Astor succeeded in merging the American Fur Company and the Columbia Fur Company in 1827 under the name of the former. By 1832 the American Fur Company was the dominant concern in the region and Fort Clark become one of its three major posts on the Missouri (Mattison, 1955).

The trade enjoyed prosperity until after 1840. But business gradually declined as the market was affected by the use of silk instead of beaver pelts for hat manufacture. After 1860, with increased hostility of Sioux Indians in the Lower Yellowstone and Upper Missouri country, the trade was nearing its end. Fort Clark was abandoned about 1860.

While the Middle Missouri merchants were prospering from 1820 to 1860, the condition of the village Indians steadily declined. A third epidemic in 1837-38 wiped out 60% of their remaining population. From the Fort Clark area, the Mandan moved up the Missouri to join the

Hidatsa where Fort Berthold was later constructed, and the Arikara moved into the old Mandan villages near Knife River. Again in 1856, these people were devastated by disease. The Arikara joined the Mandan and Hidatsa at Fort Berthold in 1862 and in 1868 an Indian agency was established there.

The villagers were at the mercy of Sioux raiders after the great epidemics. By 1850 these hostile horsemen of the high plains were easily killing hunting parties of villagers and stealing their horses. Not until after 1880, when the last Sioux were placed on reservations, did the remaining village peoples leave Fort Berthold to use other areas of their reservation (Mattison, 1955).

Mattison summarizes U.S. military activity for the area within Garrison Reservoir. Garrison Dam is about 20 miles north of the Glenharold Mine.

> The period of military occupation of the region, which began in 1864, continued without interruption until 1895. When General Alfred Sully made his Northwestern Expedition in 1864, he left a company of soldiers at both Forts Union and Berthold. Fort Buford, a few miles above the reservoir area, was established in 1866 and Fort Stevenson, within the reservoir, during the following year. These two military posts were important links in the chain of garrisons, designed to keep the Missouri River open to navigation, which extended from Fort Randall, South Dakota to Fort Benton, Montana. These forts also played an important role in the conquest of the Sioux following the Battle of the Little Bighorn. With the crushing of the power of the Sioux in the early 1880's and the coming of the railroads and settlers into the region, the value of these garrisons, in common with the other Missouri River forts, diminished. Fort Stevenson, in consequence, was abandoned in 1883 and Buford in 1895.

The Missouri Valley Indians were subdued and the fur trade was doomed by 1860. During the following decade, steamboat traffic, initiated in 1832 by the American Fur Company, increased in response to the Montana gold rush and resulting immigration. The Missouri became the major transportation route in the area, until the railroads were completed. Even after the Northern Pacific reached Bismark, North Dakota in 1873, the Upper Missouri to Fort Benton was still serviced by steamboat. Delayed by financial problems and the Sioux wars of the 1870's, the N. P. Railroad was not completed until 1883. When the transcontinental link was made by the railroad, the era of Missouri River steamboat commerce ended.

Completion of the railroads and defeat of the warring Indians opened the way for the settlement of North Dakota. Between 1878 and 1886, the eastern part of the state was populated during the Great Dakota Boom. Economic reversals and inclement weather created a depression and halted settlement efforts until 1898. Major settlement of the western part of the state and the Middle Missouri occurred between 1898 and 1918 (Leppart, 1975). The majority of settlers were 19th Century European immigrants who responded to American railroad and land company recruiting efforts overseas. The immigrants tended to live in distinct ethnic groups which led to block settlement patterns. The dominant ethnic groups near the mining area are decendants of the original German-Russian, Anglo-Saxon, and Swedish settlers (Bureau of Land Management - North Dakota State Planning Division, 1975).

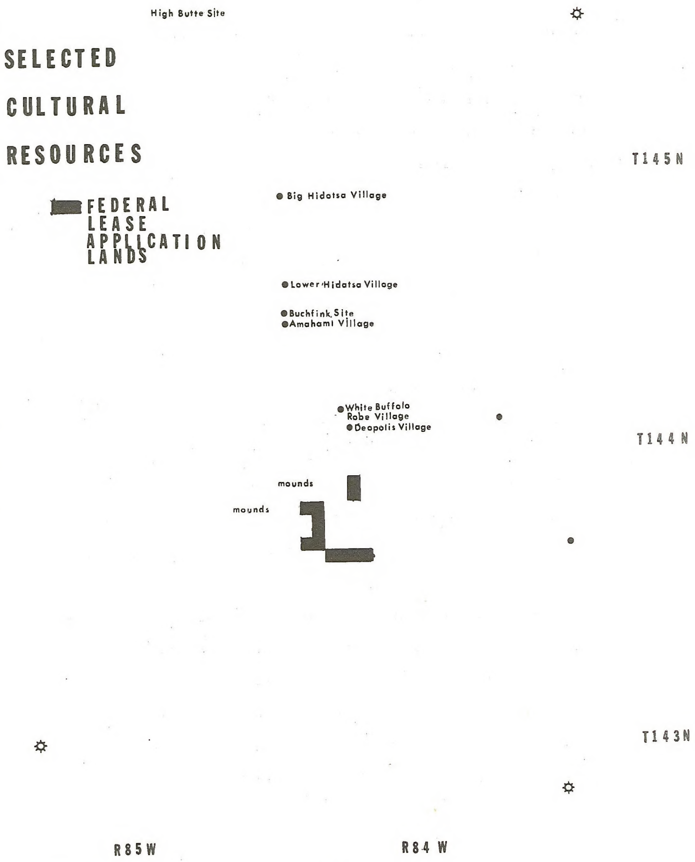

High Butte Site
SELECTED
CULTURAL
RESOURCES
FEDERAL
LEASE
APPLICATION
LANDS
Big Hidatsa Village
Lower Hidatsa Village
Buchfink Site
Amahami Village
White Buffalo
Robe Village
Deapolis Village
mounds
mounds
T145N
T144N
T143N
R85W
R84W

FIGURE A2-13

VISUAL QUALITY RATINGS

Any rating of visual quality is highly subjective because individual perception is influenced by past experiences and current expectations. In order to achieve a relatively objective rating the following procedures (adapted from BLM Manual 6310) were used to determine visual quality.

1. The rating area (the Knife River Breaks) was compared to the region identified as the "River Breaks" portion of the "Upper Missouri Basin Broken Lands" by the Northern Great Plains Resources Program (1974). This region includes the Missouri and Yellowstone Rivers and major tributaries.
2. Key factors (see Figure A2-14) of scenery were applied to the area separately. Each key factor applied to the area as a whole, not from any one location or even from a bird's-eye view.
3. Four individuals with differing backgrounds rated the area independently. The raters were familiar with the scenery of the area and region and with the concepts of this rating system. The rating results are shown in Figure A2-15.

The area received a summary rating of 9 out of a possible 24. This is an accurate reflection of the areas relative scenic quality. Landform is not as rugged as other areas in the region. Colors are generally muted and are most pronounced in the fall as a result of seasonal vegetation changes. The Missouri River adds a water component but it is not dominant. There is some variety in vegetation but it is limited to farm crops, native grass, and hardwoods. The area is not unique. There are several "intrusions" but most are related to the farming activities which characterize the area.

Scenery Quality Inventory Chart

KEY FACTORS	RATING CRITERIA AND SCORE		
① LAND FORM	Vertical or near vertical cliffs, spires, highly eroded formations, massive rock outcrops, severe surface variation. 4	Steep canyon walls, mesas, interesting erosional patterns, variety in size & shape of land forms. 2	Rolling hills, foothills, flat valley bottoms. 1
② COLOR	Rich color combinations variety or vivid contrasts in the color of soil, rocks, vegetation or water. 4	Some variety in colors and contrast of the soil, rocks & vegetation, but not dominant. 2	Subtle color variations, little contrast, generally muted tones. Nothing really eye-catching. 1
③ WATER	Still, chance for reflections or cascading white water, a dominant factor in the landscape. 4	Moving and in view or still but not dominant. 2	Absent, or present but seldom seen. 1
④ VEGETATION	A harmonious variation in form, texture, pattern, and type. 4	Some variation in pattern and texture, but only one or two major types. 2	Little or no variation, contrast lacking. 1
⑤ UNIQUENESS	One of a kind or very rare within region. 6	Unusual but similar to others within the region. 2	Interesting in its setting, but fairly common within the region. 1
⑥ INTRUSIONS	Free from aesthetically undesirable or discordant sights and influences. 2	Scenic quality is somewhat depreciated by inharmonious intrusions but not so extensive that the scenic qualities are entirely negated. 1	Intrusions are so extensive that scenic qualities are for the most part nullified. - 4

Scenery A = 15-24

Scenery B = 10-14

Scenery C = 1-9

EXPLANATION OF RATING CRITERIA

① Land Form or topography becomes more interesting as it gets steeper and more massive. Examples of outstanding land forms are found in the Grand Canyon, the Sawtooth Mountain Range in Idaho, the Wrangle Mountain Range in Alaska, and the Rocky Mountain National Park.

② Color. Consider the overall color of the basic components of the landscape (i.e., soil, rocks, vegetation, etc.) as they appear during the high-use season. Key factors to consider in rating "color" are variety, contrast, and harmony.

③ Water is the ingredient which adds movement or serenity to a scene. The degree to which water dominates the scene is the primary consideration in selecting the rating score.

④ Vegetation. Give primary consideration to the variety of patterns, forms, and texture created by the vegetation.

⑤ Uniqueness. This factor provides an opportunity to give added importance to one or all of the scenic features that appear to be relatively unique within any one physiographic region. There may also be cases where a separate evaluation of each of the key factors does not give a true picture of the overall scenic quality of an area. Often it is a number of not so spectacular elements in the proper combination that produces the most pleasing scenery - the uniqueness factor can be used to recognize this type of area and give it the added emphasis it needs.

⑥ Intrusions. Consider the impact of man-made improvements on the aesthetic quality. These intrusions can have a positive or negative aesthetic impact. Rate accordingly.

INSTRUCTIONS (See .1 for general procedures.)

Purpose: To rate the aesthetic quality of the scenic resource on all BLM lands.

How to Identify Scenery Value: All Bureau lands have scenic value.

How to Determine Minimum Suitability: All BLM lands are rated for scenic values. Also rate adjacent or intermingling non-BLM lands.

How to Delineate Rating Areas: Consider the following factors when delineating rating areas:

1. Like physiographic characteristics (i.e., land form, vegetation, etc.)
2. Similar visual patterns, texture, color, variety, etc.
3. Areas which have a similar impact from intrusions (i.e., roads, structures, mining operations, or other surface disturbances).

FIGURE A2-15

1. Date 4/22/76	UNITED STATES DEPARTMENT OF THE INTERIOR BUREAU OF LAND MANAGEMENT	CLASS	SCORE RANGE 7
2. Rater			
3. State North Dakota	QUALITY EVALUATION SCORESHEET	A	15-24
4. District Miles City	6. Recreation Activity	B	10-14
5. Plan Unit Oliver-Mercer	Glenharold Mine Sightseeing-Scenery	C	1-9

8. KEY FACTORS

9. RATING AREA NO. (a)	NAME (b)	Landform	Color	Water	Vegetation	Uniqueness	Intrusions			11. TOTAL SCORE	12. CLASS	13. REMARKS
	10. POINT MAXIMUM	4	4	4	4	6	2					
	Rater No. 1	1	1	1	2	1	1					
	Rater No. 2	2	1	1	2	1	1					
	Rater No. 3	1	2	2	2	1	1					
	Rater No. 4	1	2	2	2	2	1					
	Total	5	6	6	8	5	4					
	Average	1.25	1.5	1.5	2	1.25	1					
	Summary Rating	1	2	2	2	1	1			9	C	

Instructions on reverse)

Form 6110-10 (August 1972)

A2-91

APPENDIX 2

1974 INVENTORY OF NORTH DAKOTA OUTDOOR RECREATION FACILITIES

STATE OUTDOOR RECREATION AGENCY, 900 EAST BOULEVARD, BISMARCK, NORTH DAKOTA 58505 701/224-2430

MERCER COUNTY

NAME OF AREA	LOCATION	OWNERSHIP	TOTAL ACRES	SURFACE WATER ACRES	FISHING ACRES	RAMPS	DOCKS	BOATING, WATER SKIING ACRES	HUNTING ACRES	BEACHES	POOLS	POOL AREA (SQ FT)	HIKING, HORSEBACK MILES	BICYCLE MILES	MOTORCYCLE, SNOW MOBILE MILES	ACRES	TENT SITES	TRAILER SITES	ELECTRIC OUTLETS	ACRES	TABLES	SHELTERS	ACRES	GRASS GREENS	SAND GREENS	DIAMONDS BASEBALL AND SOFTBALL	HORSESHOE	VOLLEY BALL	BASKETBALL	TENNIS	PLAYGROUNDS	TRAP, SKEET	ARCHERY	ARENAS	SEATING	AMPHITHEATERS	SEATING	ICE SKATING RINKS	SLEDDING AREAS	SLEDDING ACRES	HOCKEY RINKS	WARMING HOUSES	SKI RUNS	SKI TOWS	VERTICAL RISE (No FEET)	CAR, MOTORCYCLE (No MILES)	SNOWMOBILE (No MILES)	SEATING	REMARKS
					FISHING					SWIMMING			TRAILS			CAMPING				PICNICKING			GOLFING			COURTS						RANGES		RODEOS		DRAMAS, CONCERTS		WINTER SPORTS								RACING			
Little Missouri River **	County	F	2,388	2388	1672			1672																																									
Garrison Dam Tailwaters	6-146-85	F	260	**	**	1	1													2	18																												
Lake Sakakawea *	County		36,240	36240	25362			25362																																									
Camp Dominic Savio	West of Pick City	P	98	*	*			*												2	8																												
Beulah Bay Recreation Area	8-146-87	M	102	*	*	2	5	*										4	4		15	5																											
Hazen Recreation Area	Sakakawea	M	80	*	*		1	*													4																												
Intake Picnic Area	31-147-84	F	103	*	*			*												50	35																												
Sakakawea State Park	25-147-85	S	661	*	*	1	4	*		1					3	300		75	75	35	177	10									1																		
Red Butte Bay	17-147-90	F	*	*	*	1	1	*																																									
Sakakawea Park	Stanton	M	112	100	100	1	1			1										5	8	1									2																		
Hazen Country Club	Hazen	P	50																				50		9																								
Horse Show Arena	E. of Hazen	P	5																															1	500														
Hazen City Park	City	M	10								1									5	12																												
Hazen-Burlington North Park	City	M	2																	1	4	1																											
Riverside & City Center Park	Beulah	M	120	50	50		5			1						5		6	6	35	15	3	175		9	1	1		3	1	2			1	5000			2									10		
Beulah Swimming Pool & Park	City	M	4								1																																						
Zap Sportsman Club	City	P	10																													1																	
Zap Municipal Park	City	M	7																	1	4	1																											
Beulah Mine Pond	N. of Beulah	S	25	3	3																																												
BLM Areas (16)	County	S	459						459																																								
Leonard Sailer Campground	Beulah	P	20													20		20																															
Jacob Weidner Campground	Beulah	P	15													15		30																															
Hazen Trailer Camper Park	City	M	4													4		6	6																														
Beaver Creek GMA	R89-T146	S/P	163						163																																								
Beulah Mine GMA	162-87-144	S/F	1,174						1,174																																								
Hills GMA	R87-T146	S/F	924						924																																								
TOTAL			43,036	38,781	37,187	6	18	27,034	2,720	3	2				3	344		141	91	136	300	21	225		18	1	1		3	1	5	1		2	5500			2									10		

FWS — U.S. FISH AND WILDLIFE SERVICE
BLM — BUREAU OF LAND MANAGEMENT
WPA — WATERFOWL PRODUCTION AREA
GMA — GAME MANAGEMENT AREA
MA — MANAGEMENT AREA
FR — OPERATED FOR PROFIT
NP — NON-PROFIT
F,M,C,S — FEDERAL, MUNICIPAL, COUNTY OR STATE
P — PRIVATELY OWNED

TABLE A2-12

APPENDIX 2

1974 INVENTORY OF NORTH DAKOTA OUTDOOR RECREATION FACILITIES

STATE OUTDOOR RECREATION AGENCY, 900 EAST BOULEVARD, BISMARCK, NORTH DAKOTA 58505 701/224-2430

OLIVER COUNTY

NAME OF AREA	LOCATION	OWNERSHIP	TOTAL ACRES	SURFACE WATER ACRES	FISHING: FISHING ACRES	FISHING: RAMPS	FISHING: DOCKS	BOATING, WATER SKIING ACRES	HUNTING ACRES	SWIMMING: BEACHES	SWIMMING: POOLS	SWIMMING: POOL AREA (SQ FT)	TRAILS: HIKING, HORSEBACK MILES	TRAILS: BICYCLE MILES	TRAILS: MOTORCYCLE SNOWMOBILE MILES	CAMPING: ACRES	CAMPING: TENT SITES	CAMPING: TRAILER SITES	CAMPING: ELECTRIC OUTLETS	PICNICKING: ACRES	PICNICKING: TABLES	PICNICKING: SHELTERS
Bubel Rodeo Arena	142-84-5	P	5																			
Mercue Mosbrucker Dam	141-83-32	P	16	14	14																	
Gullickson Dam	142-83-2	P	7	5	5																	
Price Dam	142-81-33	P	6	4	4																	
Olander Dam	141-81-9	P	14	10	10															4	1	-
Zahn Dam	143-87-28	P	10	2	2																	
Keller Dam	142-87-27	P	16	12	12																	
Bagerott Dam	142-84-19	P	4	2	2																	
Moon Dam	142-83-5	P	4	2	2																	
Tony Mosbrucker Dam	27-141-83	P	12	10	10															2	-	-
Van Oosting Dam	6-143-82	P	80	15	15															1	1	-
Center Park	City	M	17	1	1											2		3	3			
Nelson Lake	4-141-83	P	415	415	415					1										5	2	2
BLM Areas (10)	County	P	274						274													
Missouri River	County	P	4,530	4530	3171			3171														
Ridge Runner Cycle Club Track	Beulah	P	20																			
Arode Lake Management Area	R83-T143	S	384	35	35																	
Lewis & Clark GMA		S	121						121													
Smith Grove Management Area		S	24	24	24																	
TOTAL			5959	[illegible]	[illegible]			3,171	395	1						2		3	3	12	4	2

NAME OF AREA	GOLFING: ACRES	GOLFING: GRASS GREENS	GOLFING: SAND GREENS	DIAMONDS BASEBALL AND SOFTBALL	COURTS: HORSESHOE	COURTS: VOLLEY BALL	COURTS: BASKETBALL	COURTS: TENNIS	PLAYGROUNDS	RANGES: TRAP, SKEET	RANGES: ARCHERY	RODEOS: ARENAS	RODEOS: SEATING	DRAMAS, CONCERTS: AMPHITHEATERS	DRAMAS, CONCERTS: SEATING	WINTER SPORTS: ICE SKATING RINKS	WINTER SPORTS: SLEDDING AREAS	WINTER SPORTS: SLEDDING ACRES	WINTER SPORTS: HOCKEY RINKS	WINTER SPORTS: WARMING HOUSES	WINTER SPORTS: SKI RUNS	WINTER SPORTS: SKI TOWS	WINTER SPORTS: VERTICAL RISE (No. FEET)	RACING: CAR, MOTORCYCLE (No. MILES)	RACING: SNOWMOBILE (No. MILES)	RACING: SEATING	REMARKS
Bubel Rodeo Arena												1	50														
Mercue Mosbrucker Dam																											
Gullickson Dam																											
Price Dam																											
Olander Dam																											
Zahn Dam																											
Keller Dam																											
Bagerott Dam																											
Moon Dam																											
Tony Mosbrucker Dam																											
Van Oosting Dam																											
Center Park				1				1	3																		
Nelson Lake																											
BLM Areas (10)																											
Missouri River																											
Ridge Runner Cycle Club Track																								1		800	
Arode Lake Management Area																											
Lewis & Clark GMA																											
Smith Grove Management Area																											
TOTAL				1				1	3			1	50											1		800	

FWS — U.S. FISH AND WILDLIFE SERVICE
BLM — BUREAU OF LAND MANAGEMENT
WPA — WATERFOWL PRODUCTION AREA
GMA — GAME MANAGEMENT AREA
MA — MANAGEMENT AREA
PR — OPERATED FOR PROFIT
NP — NON PROFIT
F,M,C,S — FEDERAL, MUNICIPAL, COUNTY OR STATE
P — PRIVATELY OWNED

APPENDIX 3

APPENDIX 3

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ENVIRONMENTAL ANALYSIS WORKSHEET

1. Action

Consolidation Coal Company - Glenharold Mine, Stanton, North Dakota

2. Stages of implementation

Mining

3. DISCRETE OPERATIONS

(Non-Lease) Mine in general / (Lease) Mining of Federal coal

4. COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	5. ANTICIPATED IMPACTS: Soil Removal and Stockpile	Overburden Removal	Blasting, Excavation and Loading	Transportation, Delivery & Crushing		6. REMARKS
I. NONLIVING COMPONENTS						
A. AIR						
Air Movement Patterns	I/I	I/I	O/O	O/O		
Temperature	I/I	O/O	O/O	O/O		
Particulate Matter	-L/-L	I/I	I/I	-L/-L		
Exhaust Emissions	I/I	O/O	I/I	I/I		
B. LAND						
Geologic Structure	O/O	-H/H	-H/H	O/O		
Minerals	O/O	O/O	-H/-H	O/O		
Paleontology	O/O	I/I	O/O	O/O		
Topography	I/I	-H/-H	I/I	O/O		
Soil Depth	-L/-L	O/O	O/O	O/O		
Soil Structure	-H/-H	O/O	O/O	O/O		
Soil Nutrients	-L/-L	I/I	O/O	O/O		
Soil Pollutants	+L/+L	O/O	O/O	O/O		
Soil Erosion	-L/-L	O/O	O/O	O/O		
C. WATER						
Hydrologic Cycle	-M/-M	-M/-M	-H/I	O/O		
Sediment Load	-M/-M	I/I	X/X	O/O		
Dissolved Solids	-I/-I	I/I	O/O	O/O		
Chemicals, Heavy metals, Toxic substances	X/X	X/X	X/X	O/O		
Nutrients	-I/-I	-I/-I	O/O	O/O		
Solid Debris	O/O	O/O	O/O	O/O		
Coliform Contamination	O/O	O/O	O/O	O/O		
Acid Balance	O/O	O/O	O/O	O/O		
Dissolved Oxygen	I/I	X/X	X/X	O/O		
II. LIVING COMPONENTS						
A. PLANTS *(Aquatic)*						
Temperature	I/I	X/X	O/O	O/O		
Vascular	-L/-I	-I/-I	O/O	O/O		
Phytoplankton	-L/-I	-I/-I	O/O	O/O		
Floating	O/O	O/O	O/O	O/O		

(Continued on reverse)

Form 1790-3 (June 1974)

DISCRETE OPERATIONS	Soil Removal and Stockpile	Overburden Removal	Blasting, Excavation, and Loading	Transportation, Delivery & Crushing		(Non-Lease) Mine in general / (Lease) Mining of Federal coal
COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	ANTICIPATED IMPACTS					REMARKS
II. LIVING COMPONENTS (Con.)						
B. PLANTS *(Terrestrial)*						
Lichens - Mosses	-H/-H	-I/-I	O/O	O/O		
Grasses	-H/-H	-I/-I	O/O	O/O		
Forbs	-H/-H	-I/-I	O/O	O/O		
Shrubs	-H/-H	-L/-L	O/O	O/O		
Broadleaf Trees	-H/-H	-L/-L	O/O	O/O		
C. ANIMALS *(Aquatic)*						
Mammals	-L/-L	-I/-I	O/O	O/O		
Birds	-L/-L	-I/-I	O/O	O/O		
Amphibians	-M/-M	-I/-I	O/O	O/O		
Fish	X/X	X/X	O/O	O/O		
Invertebrates	-M/-M	-I/-I	O/O	O/O		
Zooplankton	-M/-M	-I/-I	O/O	O/O		
D. ANIMALS *(Terrestrial)*						
Mammals	-H/-H	-I/-I	O/O	-I/-I		
Birds	-H/-H	-I/-I	O/O	O/O		
Reptiles	-H/-H	-I/-I	O/O	-I/-I		
Invertebrates	-H/-H	O/O	O/O	O/O		
Man	-I/-I	-I/-I	-I/-I	-I/-I		
III. INTERRELATIONSHIPS						
A. ECOLOGICAL PROCESSES						
Succession	-H/-H	-L/-L	O/O	O/O		
Food Relationships	-H/-H	O/O	O/O	O/O		
Community Relationships	-H/-H	O/O	O/O	O/O		
IV. HUMAN VALUES						
A. LANDSCAPE CHARACTER						
Aesthetics					-L/-L	Cumulative Impact
B. SOCIOCULTURAL INTERESTS						
Recreation					-L/-L	Cumulative Impact
Cultural Resources	X/X	O/O	O/O	O/O		
Social/Economic Conditions					O/O	Cumulative Impact unknown - possible cancelling values
Land Use Compatability	-H/+H	-I/-I	O/O	O/O		
Land Use Suitability	+H/+H	+M/+M	+M/+M	+H/+H		

INSTRUCTIONS

1. *Action* – Enter action being taken, analytic step for which worksheet is being used, environmental viewpoint of impact, and any assumptions relating to impact.
   a. Worksheet ie normally used to analyze *"Anticipated Impacts"* of action; *however*, it may be used to analyze *"Residual Impacts."* Worksheets may also be used to compare impacte before and after mitigating measures are applied.
   b. State viewpoint that best describes environmental impact. For example, e fence viewed down the fence line has greater impact than the same fence viewed over an entire allotment. Generally, narrow viewpoints better illustrate specific impacts than will broad viewpoints.
   c. Assumptions mey be made to establish a base for analyeis *(e.g. estimated time periods, season of year, etc.)*.
2. *Stages of Implementation* – Identify different phaees of proposed project *(e.g. a road project consists of survey, construction, use, and maintenance stages)*.
3. *Discrete Operations* – Identify separate actions comprising e particular stage of implementation *(e.g. the construction stage of the road project has the discrete operations of clearing, grading, and surfacing)*.
4. *Elements Impacted* – Enter under appropriate heading all environmental elements susceptible to impact from action and alternatives. Relevant elemente not contained in the digest should also be entered. See BLM Manual 1791, Appendix 2, Environmental Digeet.
5. *Anticipated Impact* – Evaluate anticipated impect on eech element and plece en entry in the appropriate square indicating degree of impact as low (L), medium (M), high (H), no impact (O), or unknown or negligable (X). Preceed each entry by a plus (+) or minus (-) sign indiceting a beneficial or adverse type of impact. If type of impact reflecte a matter of opinion or is not known, *do not* preceed with a sign. For example, construction of a wind mill on open range hes a definite visual impact; *however*, to some people tha effect ie detrimental while to others it is an improvement. By not entering a plus (+) or minus (-) sign tha worksheet is kept factual and unbiased. If both degree and type of impact are unknown, place an (x) in the appropriate square.
   a. The measuree of impact *(e.g. low, medium, and high)* are relative and their meaning may vary slightly from action to action. The term *"low"* should not be applied to impacts of a negligible nature. For example, we know that a pickup truck driving down a propoeed fence line laying wire has some impact on air quality. However, the significance of this impact is not normally great enough to warrant even a *"low"* rating. In cases like this, the impact will usually be marked "O" or the element left off the worksheet.
   b. It is recognized that some environmental elements may defy accurate measurement or in-depth analysis within current Bureau capabilities or expertise. The nature of the action as well as type and degree of impact should guide in the decision to seek outeide expertiee or aseistance.
6. *Remarks* – Enter clarifying information.

☆U.S. GOVERNMENT PRINTING OFFICE 1974 — 781-666

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ENVIRONMENTAL ANALYSIS WORKSHEET

1. Action

Consolidation Coal Company - Glenharold Mine, Stanton, North Dakota

2. Stages of implementation

Reclamation

3. DISCRETE OPERATIONS

(Non-Lease) Mine in general / (Lease) Mining of Federal coal

	4. COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	5. ANTICIPATED IMPACTS: Regrading	Topsoiling	Revegetation			6. REMARKS
I. NONLIVING COMPONENTS	A. AIR						
	Air Movement Patterns	I/I	O/O	I/I			
	Temperature	O/O	O/O	I/I			
	Particulate Matter	-L/-L	-L/-L	I/I			
	Exhaust Emissions	I/I	I/I	I/I			
	B. LAND						
	Geologic Structure	O/O	O/O	O/O			
	Minerals	O/O	O/O	O/O			
	Paleontology	O/O	O/O	O/O			
	Topography	+M/+M	I/I	O/O			
	Soil Depth	+L/-L	+H/+H	+L/+L			
	Soil Structure	I/I	-H/-H	+L/+L			
	Soil Nutrients	I/I	+H/+H	+H/+H			
	Soil Pollutants	X/X	I/I	O/O			
	Soil Erosion	+M/+M	-L/-L	+H/+H			
	C. WATER						
	Hydrologic Cycle	+M/+M	+M/+M	+M/+M			
	Sediment Load	+L/+L	O/O	+H/+H			
	Dissolved Solids	I/I	I/I	+I/+I			
	Chemicals, Heavy metals, toxic substances	X/X	O/O	X/X			
	Nutrients	O/O	-I/-I	-I/-I			
	Solid Debris	O/O	O/O	O/O			
	Coliform Contamination	O/O	O/O	O/O			
	Acid Balance	O/O	O/O	I/I			
	Dissolved Oxygen	I/I	I/I	X/X			
II. LIVING COMPONENTS	A. PLANTS *(Aquatic)*						
	Temperature	O/O	O/O	X/X			
	Vascular	+I/+I	+L/+L	X/X			
	Phytoplankton	+I/+I	+L/+L	O/O			
	Floating	O/O	O/O	O/O			

(Continued on reverse)

DISCRETE OPERATIONS	Regrading	Topsoiling	Revegetation		(Non-Lease) Mine in general / (Lease) Mining of Federal coal	
COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	**ANTICIPATED IMPACTS**					**REMARKS**
II. LIVING COMPONENTS (*Con.*)						
B. PLANTS *(Terrestrial)*						
Lichens - Mosses	X/X	X/X	O/O			
Grasses	+I/+I	+M/+M	+H/+H			
~~Forbs~~	+I/+I	+M/+M	+H/+H			
Shrubs	-L/-L	+M/+M	X/X			
Broadleaf Trees	-L/-L	+L/+L	X/X			
C. ANIMALS *(Aquatic)*						
Mammals	+I/+I	+I/+I	X/X			
Birds	+I/+I	+I/+I	X/X			
Amphibians	+I/+I	+I/+I	+M/+M			
Fish	X/X	X/X	X/X			
Invertebrates	+I/+I	+I/+I	X/X			
Zooplankton	+I/+I	+I/+I	X/X			
D. ANIMALS *(Terrestrial)*						
Mammals	+I/+I	+L/+L	+H/+H			
Birds	+I/+I	+L/+L	+H/+H			
Reptiles	+I/+I	+L/+L	+H/+H			
Invertebrates	O/O	+M/+M	+H/+H			
Man	+I/+I	+I/+I	+I/+I			
III. INTERRELATIONSHIPS						
A. ECOLOGICAL PROCESSES						
Succession	X/X	+H/+H	+H/+H			
Food Relationships	O/O	+M/+M	+H/+H			
Community Relationships	O/O	+M/+M	+H/+H			
IV. HUMAN VALUES						
A. LANDSCAPE CHARACTER						
Aesthetics					+L/+L	Cumulative Impact
B. SOCIOCULTURAL INTERESTS						
Recreation					+L/+L	Cumulative Impact
Cultural Resources	O/O	O/O	O/O			
Social/Economic Conditions					O/O	Cumulative Impact Unknown - possible cancelling values
Land Use compatibility	X/X	+H/+H	+H/+H			
Land Use Suitability	+M/+M	+M/+M	+M/+M			

INSTRUCTIONS

1. *Action* — Enter action being taken, analytic step for which worksheet is being used, environmental viewpoint of impact, and any assumptions relating to impact.
   a. Worksheet is normally used to analyze *"Anticipated Impacts"* of action; *however*, it may be used to analyze *"Residual Impacts."* Worksheets may also be used to compare impacts before and after mitigating measures are applied.
   b. State viewpoint that best describes environmental impact. For example, a fence viewed down the fence line has greater impact than the same fence viewed over an entire allotment. Generally, narrow viewpoints better illustrate specific impacts than will broad viewpoints.
   c. Assumptions may be made to establish a base for analysis *(e.g. estimated time periods, season of year, etc.)*.
2. *Stages of Implementation* — Identify different phases of proposed project *(e.g. a road project consists of survey, construction, use, and maintenance stages)*.
3. *Discrete Operations* — Identify separate actions comprising a particular stage of implementation *(e.g. the construction stage of the road project has the discrete operations of clearing, grading, and surfacing)*.
4. *Elements Impacted* — Enter under appropriate heading all environmental elements susceptible to impact from action and alternatives. Relevant elements not contained in the digest should also be entered. See BLM Manual 1791, Appendix 2, Environmental Digest.
5. *Anticipated Impact* — Evaluate anticipated impact on each element and place an entry in the appropriate square indicating degree of impact as low (L), medium (M), high (H), no impact (O), or unknown or negligable (X). Preceed each entry by a plus (+) or minus (−) sign indicating a beneficial or adverse type of impact. If type of impact reflects a matter of opinion or is not known, *do not* preceed with a sign. For example, construction of a wind mill on open range has a definite visual impact; *however*, to some people the effect is detrimental while to others it is an improvement. By not entering a plus (+) or minus (−) sign the worksheet is kept factual and unbiased. If both degree and type of impact are unknown, place an (x) in the appropriate square.
   a. The measures of impact *(e.g. low, medium, and high)* are relative and their meaning may vary slightly from action to action. The term *"low"* should not be applied to impacts of a negligible nature. For example, we know that a pickup truck driving down a proposed fence line laying wire has some impact on air quality. However, the significance of this impact is not normally great enough to warrant even a *"low"* rating. In cases like this, the impact will usually be marked "O" or the element left off the worksheet.
   b. It is recognized that some environmental elements may defy accurate measurement or in-depth analysis within current Bureau capabilities or expertise. The nature of the action as well as type and degree of impact should guide in the decision to seek outside expertise or assistance.
6. *Remarks* — Enter clarifying information.

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APPENDIX 3

Definitions of Impact Rating Terms Applied to Vegetation and Wildlife During This Analysis*

Impact Rating Term	Definitions
High Positive	Increase in parametric value of 50 percent or more; should be confirmable within 3 years.
Moderate Positive	Increase in parametric value of 25 to 50 percent; should be confirmable within 3 to 10 years.
Low Positive	Increase in parametric value of 10 to 25 percent; not usually confirmable within 10 years.
No Change (Insignificant)	Increase or decrease in parametric value of less than 10 percent; not confirmable within useful period of time.
Low Negative	Decrease in parametric value of 10 to 25 percent; not usually confirmable within 10 years.
Moderate Negative	Decrease in parametric value of 25 to 50 percent; should be confirmable within 3 to 10 years.
High Negative	Decrease in parametric value of 50 percent or more; should be confirmable within 3 years.

*Wildlife was considered by major component category (see analysis worksheets). Adapted from "Oil Shale Development and Wildlife in Northwestern Colorado," by L. W. Carlson and A. T. Cringan dated 1975. Wildlife Society Bulletin Vol. 3(1).

ANALYSIS OF IMPACTS - ELU's

In an attempt to reflect the significance of the changes in the environment following mining, each basic environmental component of the natural ELU's within the proposed lease tracts were rated by the analysis team (See Table 1). The ELU components were rated from zero to three depending on its relative value to that ELU. Zero represents no value and three represents the highest. All component ratings were totaled, thus establishing an arbitrary Base Level Value for each ELU.

Table 1

BASE LEVEL VALUES

	Air	Soils	Water	Plants	Animals	Economic ← HUMAN VALUES	→ Non-Economic	Base Level Value
DP-PWT	2	1	3	3	3	1	2	15
DP-SG	2	2	2	2	2	2	1	13
DP-AG	2	2	2	1	1	3	1	12
	6	5	7	6	6	6	4	

Table 2 reflects the relative change in each ELU that would result from mining and reclamation. The value destroyed during each step in mining was subtracted from the Base Level Value. The numerical value subtracted is modified by the area of that ELU which would be mined. In reclamation, the replaced values were numerically added. The total after reclamation was compared with the Base Level Value. The Residual Difference shows the total resource difference between the reclaimed and natural ELU's. This comparison is subjective and arbitrary, but it suggests the difference between pre-mining and post-reclamation activities. It demonstrates numerically that reclamation cannot restore all resource values.

Table 2

RESIDUAL DIFFERENCE

	DP-PWT	DP-SG	DP-AG
Base Level Value	15	13	12
Topsoil Removal	-10	-8	-8
Overburden Removal	-2	-1	-2
Blasting and Excavation	0	0	0
Transportation and Crushing	0	0	0
TOTAL	-12	-9	-10
Regrading	+2	+1	+2
Topsoiling	+3	+3	+7
Revegetation	+2	+3	+1
TOTAL	+7	+7	+10
Residual Difference (±)	-5	-2	0

APPENDIX 4

APPENDIX 4

Criteria for Nominating Sites of State, National, or Local Significance to the National Register of Historic Places

The criteria applied to evaluate properties for possible inclusion in the National Register are listed below. These criteria are worded in a manner to provide for the diversity of resources. The following criteria shall be used in evaluating properties for nomination to the National Register, by the National Park Service in reviewing nominations, and for evaluating National Register eligibility of properties affected by Federal agency undertakings.

National Register Criteria for Evaluation. The quality of significance in American history, architecture, archeology, and culture is present in districts, sites, buildings, structures, and objects of State and local importance that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and

(a) That are associated with events that have made a significant contribution to the broad patterns of our history; or

(b) That are associated with the lives of persons significant in our past; or

(c) That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

(d) That have yielded, or may be likely to yield, information important in prehistory or history.

Criteria Considerations. Ordinarily cemeteries, birthplaces, or graves of historical figures, properties owned by religious institutions or used for religious purposes, structures that have been moved from their original locations, reconstructed historic buildings, properties primarily commemorative in nature, and properties that have achieved significance within the past 50 years shall not be considered eligible for the National Register. However, such properties will qualify if they are integral parts of districts that do meet the criteria or if they fall within the following categories:

(a) A religious property deriving primary significance from architectural or artistic distinction or historical importance.

(b) A building or structure removed from its original location but which is significant primarily for architectural value, or which is the surviving structure most importantly associated with a historic person or event.

(c) A birthplace or grave of a historical figure of outstanding importance if there is no appropriate site or building directly associated with his productive life.

(d) A cemetery which derives its primary significance from graves of persons of transcendent importance, from age, from distinctive design features, or from association with historic events.

(e) A reconstructed building when accurately executed in a suitable environment and presented in a dignified manner as part of a restoration master plan, and when no other building or structure with the same association has survived.

(f) A property primarily commemorative in intent if design, age, tradition, or symbolic value has invested it with its own historical significance.

(g) A property achieving significance within the past 50 years if it is of exceptional importance.

APPENDIX 5

GLOSSARY

A1 horizon - The surface layer of soil.

A2 horizon - A light colored leached or bleached soil layer that sometimes occurs just below the A1 horizon.

alkaline soil - A soil that has either so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or higher) or both that the growth of most plants is reduced.

alluvium - Clay, silt, sand, gravel, or other rock materials transported by flowing water and deposited in comparatively recent geologic time as sorted or semisorted sediments in riverbeds, estuaries, and flood plains, on lakes, shores, and in fans.

aquifer - Layers, stringers and pockets of material beneath the land surface saturated with water.

artesian well - Water in a well rising as a result of natural pressure. Commonly the water flows at the land surface with considerable pressure.

autotrophic - Ecologically speaking, these are "producer" organisms which construct or build organic substances (i.e., green (chlorophyll) plants).

available water capacity - Soil water that is available to plants for growth; 1/3 bar to 15 bars.

B horizon - Subsoil; the soil layer below the A horizon.

biome - A major biotic unit consisting of plant and animal communities having similarities in form and environmental conditions.

biotic - Anything being of, or related to life, or having a specified mode of life.

box cut - The initial cut driven in a property, where no open side exists; this results in a highwall on both sides of the cut.

C horizon - Substratum; the soil layer below the B horizon; may be parent material.

calcareous - Soil containing sufficient free calcium carbonate to effervesce (bubble) visibly when trated with cold 0.1 N Hydrochloric acid.

calcium carbonate - $CaCO_3$; limestone.

calcium sulfate - $CaCO_4$; gypsum.

capability class - Reflects the relative capability of the soil to produce commonly grown crops on a sustained basis, Class I being the best and class VIII the poorest.

carnivore - Flesh eating organism.

cfs - The volume of water represented by the flow of one cubic foot per second.

channery - As used here scoria.

climax - The final or mature community in the natural process of succession.

coliform - A group of bacterial micro-organisms commonly found in the intestinal waste from warm-blooded animals. This bacterial group is often used as an indicator of sewage pollution in water supplies.

community - All the populations occupying a given area.

consequent drainage - A stream course controlled by the form and slope of the land surface.

continental climate - Climatic conditions originating over a large land mass.

coulee - A long, narrow, steep sided water channel where water accumulates.

cropline - A line following the coal outcrop.

cultural resources - The sites, structures, objects, ruins, art work, architectural works, burials, artifacts and other evidences of human endeavor that are still evident on the land.

cultural resource survey - A research oriented inventory of archaeological or historic sites made to gather research data and usually problem oriented.

dead ice moraine - Ablation till.

disclimax - The biotic state when a stable community, which is not the climatic or edaphic climax for the given site, is maintained by man or his domestic animals disturbance climax.

dragline - A type of excavation equipment which casts a rope-hung bucket a considerable distance, collects the dug material by pulling the bucket toward itself on the ground with a second rope, elevates the bucket, and dumps the material on a spoil bank, in a hopper, or on a pile.

ecosystem - Complex self-sustaining natural system which includes living and non-living components of the environment and the interactions that bind them together. Its functioning involves the circulation of matter and energy between organisms and their environment.

effective rooting depth - The total depth to which plant roots can penetrate the soil without restriction; e.g. claypan, bedrock or water table.

endemic species - Those organisms that are produced, growing, or living naturally in a particular area. Native species.

evaporation - The return of water in a vapor state to the atmosphere.

evapotranspiration - The return of water to the atmosphere by evaporation and transpiration of vegetation.

final cut - The last cut in a strip mine. A highwall will result on one side.

flood plain - The portion of a river valley, adjacent to the river's channel, that is relatively flat and wide and becomes covered with water when the river overflows its banks.

fluvial - Applied to sand and gravel deposits laid down by streams or rivers. Such deposits are of fluvial origin.

food chain - The process of the transfer of food energy from the source in plants through a series of organisms with repeated eating and being eaten.

glacial drift - Boulders, till, gravel, sand, or clay transported by a glacier or its meltwater.

glacial till - Material deposited by glaciation, usually composed of a wide range of particle sizes, which have not been subjected to the sorting action of water.

gpm - The volume of flowing water measured as one gallon per minute.

ground moraine - The irregular sheet of till deposited partly beneath the advancing glacier and partly directly from the ice when it melts away.

ground water - Water beneath the land surface.

habitat - A specific set of physical conditions that surround the single species, a group of species, or a large community. For wildlife, the major habitat components are considered to be food, water, cover, and living space. An organism's "home".

head (hydraulic head) - The height of a fluid column, usually considered as water, which maintains a pressure on a surface.

heavy metals - The elemental metallic cations that have the capability of interfering with, or interrupting, the normal physiological processes of organisms when present in excessive quantities. In excessive quantities, these elements (i.e., lead, zinc, mercury, Arsenic, etc.) are an environmental pollutant.

herbivore - Plant eating organism.

heterotrophic - Ecologically speaking, these are "consumer" (i.e., mammals) and "reducer" (i.e., fungi) organisms which destroy organic substance.

highwall - The face or bank on the uphill side of a contour strip mine excavation.

hydraulic conductivity - The ability of water to move through subsurface material.

hrdrophyte - A plant that grows in water or in wet or saturated soils.

infiltration - The flow or movement of water through the soil surface into the ground.

inflow - The flow of water into a surface or ground water source.

intermittent stream - A stream that flows only part of the time.

kettle - A depression in the groun surface formed by the melting of a block of ice buried or partially buried by glacial drift, either outwash or till.

knob - An isolated, prominent rounded hill or mountain.

Known Coal Leasing Area (KCLA) - A region, designated by the U.S. Geological Survey, as an area where coal of commercial quantities is known to exist.

lignite - A brownish-black coal in which the alteration of vegetal material has proceeded further than in peat but not so far as subbituminous coal.

limiting factor - A critical living or non-living element of an ecosystem necessary for an organism to survive that is in the least supply.

loess - Material transported and deposited by wind and consisting predominently of silt sized particles.

long ton - 2,240 pounds (= a metric ton).

macro-invertebrate - Any invertebrate animal which can be viewed or observed without the aid of a microscope.

meander - A series of somewhat regular curves, bends or windings in the course of a stream.

megawatt - A million watts.

mesophyte - A plant that grows under intermediate moisture conditions.

mg/l - Milligrams per litre, the amount of chemicals present in a one litre of water expressed in milligrams which is one thousandth of a gram.

micro-invertebrate - An invertebrate animal so small as to require a microscope for easy viewing.

moraine - An accumulation of earth and stones carried and finally desposited by a glacier.

natural drainage classes -

excessively drained - usually sandy or gravelly soils; droughty
well drained - no water table within 40" of the surface
moderately well drained - water table within 20-40" of the surface
somewhat poorly drained - Water table within 10-20" of the surface
poorly drained - water table within 0-10" of the surface
very poorly drained - water standing on surface.

niche - The functional status of an organism in the ecosystem. An organism's "job".

orphan spoils - A spoils pile or waste dump not reclaimed or leveled.

overburden - Material of any nature, consolidated on unconsolidated, that overlies a deposit of useful materials, ores, or coal, especially those deposits that are mined from the surface by strip mining.

parent material - The unconsolidated and more or less chemically weathered mineral or organic matter from which the solum of soils is developed by pedogenic processes.

perennial stream - A stream that flows year around.

permeability - The rate at which water moves through the soil.

pH - The relative acidity or alkalinity of the soil with pH 7.0 being neutral; greater than 7.0 increasingly alkaline and less than 7.0 increasingly acid.

physiognomy - The surface character or features of the land, external aspect.

physiography - Physical geography; a description of the natural features of the surface of the earth.

piezometric surface - The surface to which the water from a given aquifer will rise under its full head.

piping - The movement of soil particles by percolating water leading to the development of channels.

plateau - An elevated piece of flat land with at least one side having an abrupt drop-off to lower land.

pollutant - Any agent or form that makes entrance into another material or organism and affects that material or organism in a deleterious fashion or creates a condition in the environment that's offensive to the aesthetic sense.

potentiometric gradient - Potential gradient means an ascending or descending value of voltage related to a linear measurement, as a distance along the earth surface or ground.

potholes - Shallow water holding depressions of glacial origin.

ppm - The amounts of chemicals present in a water sample represented by the measure of one part per million.

precipitation - The discharge of water from the atmosphere to the earth's surface in the form of rain, snow, hail, sleet, etc.

range site - A group of similar soils that produce similar types and amounts of native vegetation; e.g. silty range site.

relief - The elevations or inequalities of a land surface.

residual soil - A soil formed from or resting on consolidated rock of the same kind as that from which it was formed, and in the same location.

runoff - The part of precipitation appearing in surface streams.

scoria - Slaglike clinkers, burned shale and fine grained sandstone; characteristic of burned out coal beds.

selective denial - An administrative process by which an action can be modified, in part, by denying the prescribed activity.

seral stage - The relatively transitory, intermediate communites prior to climax in the ecological process of succession.

sheet moraine - ground moraine - dead ice moraine - ablation till.

short ton - 2,000 pounds.

slumping - When the soil and earthy material on a steep slope become charged with water, their weight is greatly increased. At the same time the water makes them more mobile. Under these circumstances the material sometimes slides down the slopes.

sodium absorbtion ratio (SAR) - An index of the amount of sodium in a soil.

soil series - The basic unit of soil classification being a subdivision of a family and consisting of soils which are essentially alike in all major profile characteristics except the nature of the A horizon.

sola, solum - The A horizon plus the B horizon.

solubility - The amount of material that can be dissolved by water.

spring - A place where water from rocks or soil upon the land or into a body of surface water.

stratigraphy - That part of the descriptive geology of an area or district which pertains to the discrimination, character, thickness, sequence, age, and correlation of the rocks of the district.

stripping ratio - The unit amount of spoil or waste that must be removed to gain access to a similar unit amount of ore or mineral material (coal).

succession - The progressive development of vegetation toward its highest ecological expression, the climax; the natural process of replacement of one plant community by another.

terraces - Step like form of land generally long and narrow with one side having a steep dropoff and the other having a steep rise.

texture - The relative proportions of sand, silt and clay in a soil, e.g. sandy loam.

topography - The configuration of a surface including its relief.

trophic level - Feeding level in the food chain. In complex natural communities, organisms whose food is obtained by the same number of steps are said to belong to the same trophic (feeding) level (i.e., producers, primary consumers, secondary consumers, etc.).

ug/l - Micrograms per litre, the amount of chemicals present in a one litre of water expressed in micrograms which is one thousandth of a milligram.

underflow - The flow of water beneath a structure.

zooplankton - Minute floating animals found in aquatic habitats.

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