ANDALEX RESOURCES, INC.

APPLICATION FOR PERMIT RENEWAL

ACT 007/019-1

VOLUME I

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EXHIBITS

I. Introduction and Overview of Project and Permit Application

A. Introduction

This underground mining permit application is being submitted by Andalex Resources, Inc., in order that coal might be mined from Federal mining leases located within the proposed mine plan area and property boundaries. This proposed mine plan area is known as the Centennial Project. Andalex Resources, a corporation organized and existing under the laws of Delaware and qualified to do business in Utah, has opened an underground mine known as the Pinnacle Mine. This mine is located on fee land in Carbon County, Utah. Andalex the designated operator, along with AMCA Coal Leasing, Inc., its land acquisition and development branch, control all Federal and fee mining leases within the proposed mine plan area. This underground mining permit application has been prepared by Andalex Resources and is being submitted for review and approval by the appropriate regulatory authorities.

B. Overview and Summary of Project

Mining operations at the Pinnacle Mine began on October 3, 1980, according to the Mining and Reclamation Plan approved by the State of Utah, Department of Natural Resources, Division of Oil, Gas, and Mining. The Pinnacle Mine is located and operating on the Zion's fee lease. Mine plans call for advancement of operations onto Federal leases contained within the proposed mine plan area and the simultaneous operation of a mine in each of the three mineable coal seams present, the Lower Sunnyside Seam, the Gilson Seam, and the Aberdeen Seam. Current mining activity is occurring in the Gilson Seam. The coal is classified as High-volatile B bituminous in both the Lower Sunnyside and Gilson Seams and as High-volatile A bituminous in the Aberdeen Seam.

The proposed mine plan area is located approximately 10 miles north-northeast of Price, Utah in Carbon County in T13S and R11E (See Figure I-1 and Plate I). The property contains approximately 2,798 acres. Two hundred acres is fee surface and coal leased from the Zion Security Corporation. The remaining 2,598 acres is Federal lease consisting of SL-027304 (236 acres), SL-063058 (400 acres), and U-010581 (1,842.39 acres). See Plate 4.

This property is located in the Book Cliffs coal field and includes the Deadman Canyon, Starpoint Canyon, and Straight Canyon areas with coal outcropping along the cliffs between 7,000 feet and 7,700 feet elevations. The topography is very rugged, the Book Cliffs being dissected by box canyons created by ephemeral streams. Large sandstone boulders eroded from the cliffs are scattered along the sides of the canyons. The land is undeveloped, used primarily for grazing, and there are no areas of national importance in the region. Mountain-Brush vegetative type covers most of the area.

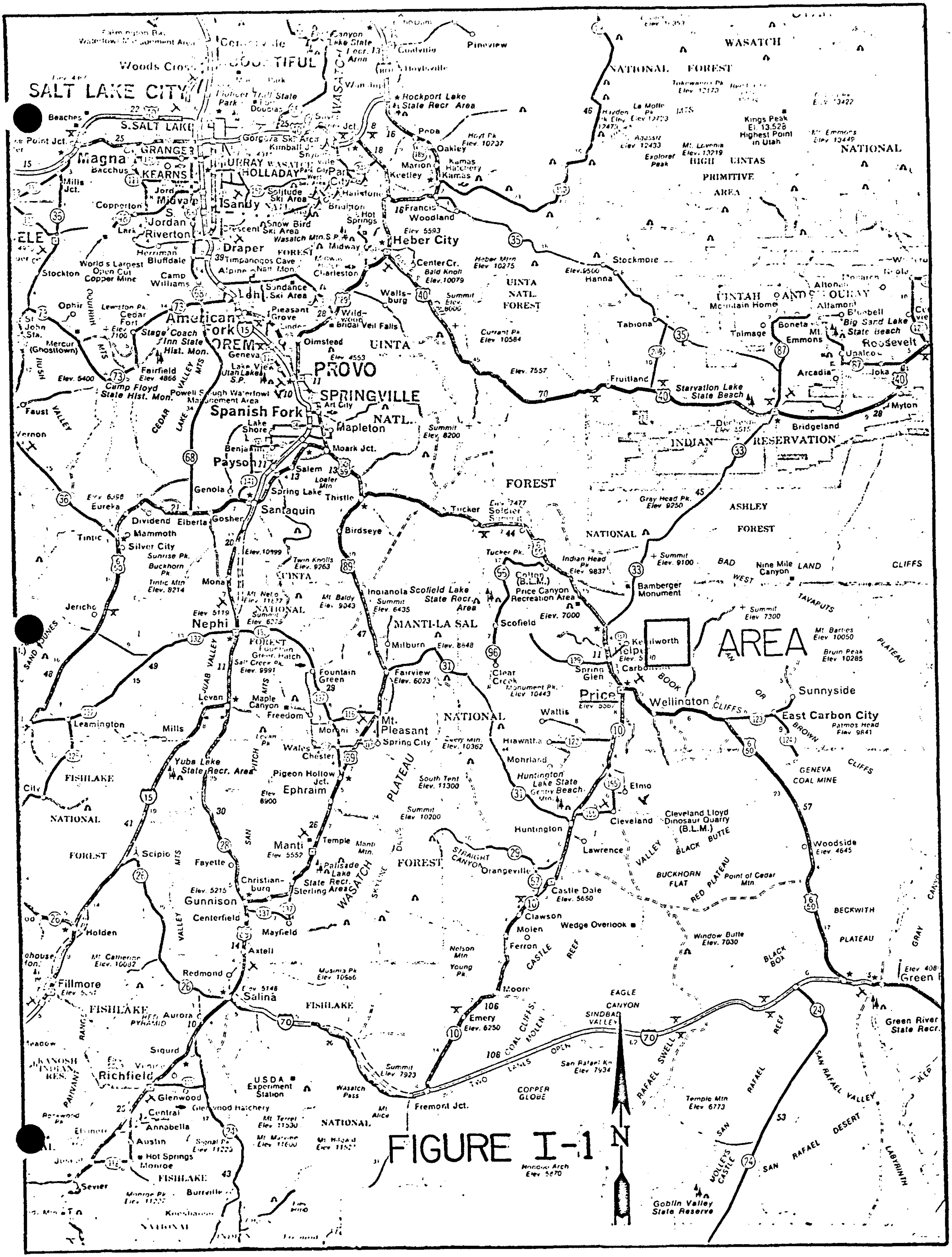

SALT LAKE CITY
BOUNTIFUL
S.SALT LAKE
Magna
GRANGER
KEARNS
MURRAY
HOLLADAY
Midvale
Sandy
S. Jordan
Riverton
Draper
Heber City
Park City
WASATCH
NATIONAL FOREST
Kings Peak
Highest Point in Utah
HIGH UINTAS
PRIMITIVE AREA
Stockmore
Hanna
UINTA NATL. FOREST
Tabiona
Fruitland
Starvation Lake State Beach
UINTAH AND OURAY
INDIAN RESERVATION
Roosevelt
Myton
Bridgeland
Duchesne
American Fork
OREM
PROVO
SPRINGVILLE
Spanish Fork
Mapleton
Payson
Santaquin
Nephi
Eureka
FOREST
ASHLEY FOREST
NATIONAL
Scofield Lake State Recr. Area
MANTI-LA SAL
Price Canyon Recreation Area
Scofield
Helper
Kenilworth
AREA
Price
Wellington
East Carbon City
Sunnyside
BOOK CLIFFS
Fairview
Mt. Pleasant
Spring City
Ephraim
Manti
Gunnison
Salina
Richfield
NATIONAL
FISHLAKE
PLATEAU
WASATCH
Huntington
Cleveland
Elmo
Castle Dale
Orangeville
Ferron
Emery
Moore
SAN RAFAEL SWELL
SAN RAFAEL DESERT
Goblin Valley State Reserve
Green River
Woodside
Fremont Jct.
Sevier
Monroe
Fillmore
N

FIGURE I-1

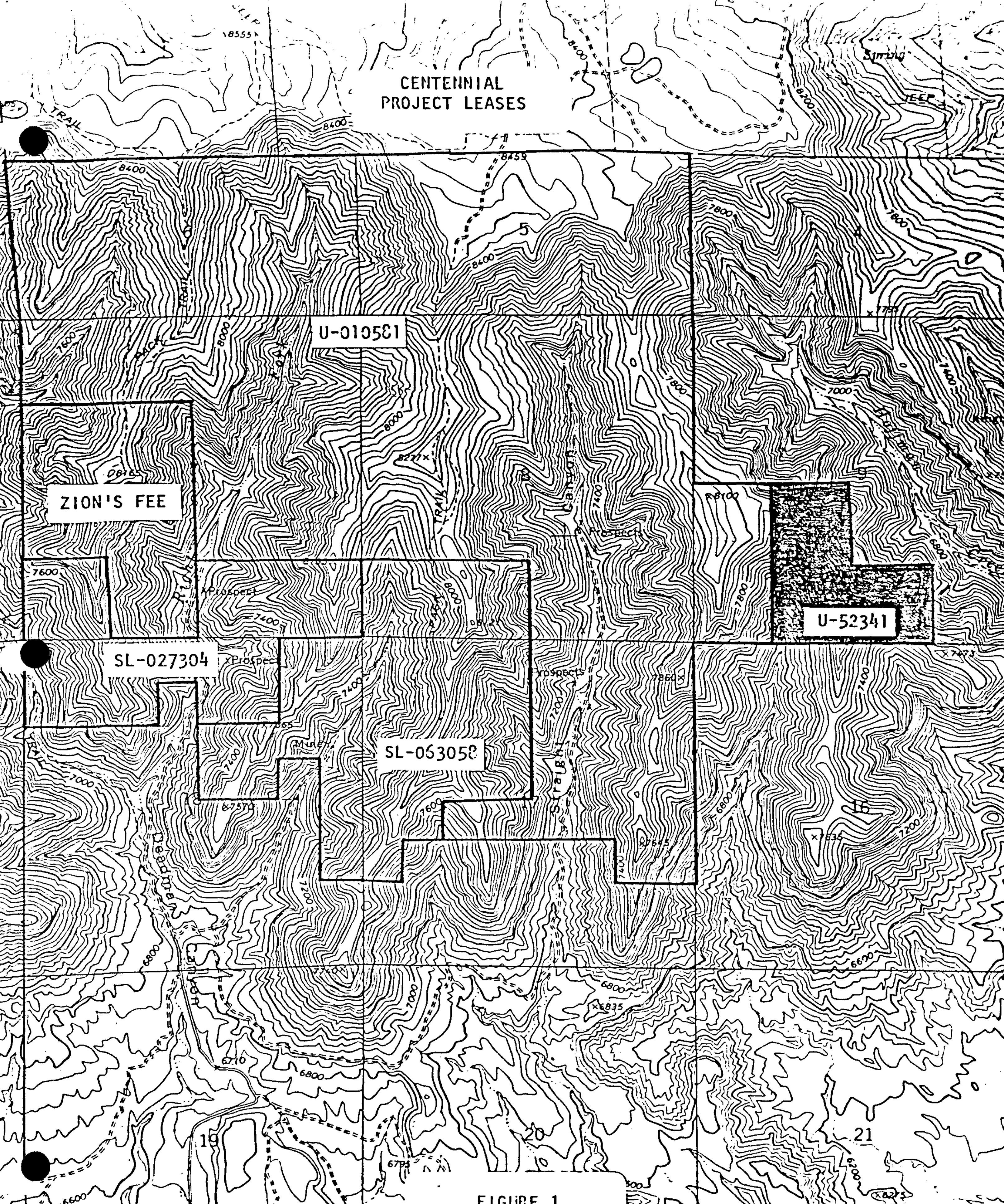

CENTENNIAL
PROJECT LEASES
U-010581
ZION'S FEE
SL-027304
SL-063058
U-52341
Prospect
Prospects
TRAIL
5
4
6
8
9
16
19
20
21
8400
8000
7800
7600
7400
7200
7000
6800

FIGURE 1

There are no perennial streams or bodies of water on the property. Ground water recharge is from precipitation in the vicinity. Water supply for mine development and culinary usage is supplied by wells that have been drilled.

Historically, coal mining has been the only industry in the permit area and there are several abandoned mines located on the property. No oil or gas wells exist in the area as geologic conditions are not appropriate.

Access to the mine plan area is by an existing graveled county road which has been upgraded and is maintained by Andalex. It is used as an access road as well as a haul road. All surface and support facilities necessary for present operations have been completed and are located on the Zion's fee or on right-of-ways granted by the Bureau of Land Management. All proposed facilities are indicated in this application. Andalex has acquired all applicable state and Federal licenses, permits, and right-of-ways necessary to conduct mining activities on the Zion's fee property and contiguous Federal leases.

Estimated coal reserves in the three beds of mineable thickness totals 50 million tons, with recoverable coal estimated at 29 million tons. Production schedule projects an increase from 200,000 tons the first year to full production of about 1,200,000 tons in the fourth and fifth years. At this rate, the life of the mine is estimated to be about 30 years, with a theoretical life of about 40 years due to the existence of additional unleased Federal coal economically accessible only through Andalex's operation.

The initial mining method being employed is pillar development utilizing one continuous miner section of equipment with final pillar extraction planned. An additional 5 mining units will be added, according to production schedule, with mining development occurring simultaneously in each of the three seams. Longwall mining may be introduced later if conditions prove adaptable; however, the basic overall mine plan will not be changed.

Upon cessation of mining activities, reclamation activities will commence as soon as is practicable, according to the plans outlined in this application. The land will be restored according to available technology to as nearly its original condition as is possible.

This operation does not face any of the mining complications caused by faults, instrusives, excessive water, large quantities of gas or considerably deep cover. The mine plan area is located in a region where mining has been the major industry; therefore, the nearby communities are geared for coal operations. The labor supply is excellent and well trained. With these considerations, and Andalex's prudent management, the Centennial Project will be a model mining operation in the Carbon County area with very minimal environmental and socioeconomic impact.

C. Organization of Application

This underground mining permit application has been organized in accordance with the general requirements for format and contents as outlined in Section 771.23 of Title 30 of the Code of Federal Regulations. The text has been organized into eight chapters to fulfill the requirements of Subchapter G of 30 CFR. A summary of the table of contents is listed below.

Summary of Table of Contents

Chapter I	Introduction and Overview of Project and Permit Application
Chapter II	Legal, Financial, Compliance and Related Information
Chapter III	Operation and Reclamation Plan
Chapter IV	Environmental Resources
Chapter V	Maps, Cross Sections and Plans
Chapter VI	Preparation of Application
Chapter VII	Cross-Reference Table to Regulations in 30 CFR, Chapter VII
Chapter VIII	Appendices

To facilitate review of the application, each chapter listed above has been further divided into specific parts and sections. These can be found listed in the detailed table of contents appearing at the beginning of this text along with the page numbers on which they appear. This table of contents also contains lists of figures, tables, plates, exhibits, and appendices to facilitate cross referencing between chapters.

Exhibits include appropriate supporting documents, reports and publications and are included as appendices.

Maps which were not reduced to fit into the text are included in a separate volume as plates. All maps and plans are submitted in accordance with the requirements of Section 771.23(e) 30 CFR.

VERIFICATION STATEMENT

STATE OF Utah

COUNTY OF Carbon

I, Michael W. Glasson, having been duly sworn, depose and attest that all of the representations contained in the foregoing application are true to the best of my knowledge; that I am authorized to complete and file this application on behalf of the Applicant and this application has been executed as required by law.

Signed: [signature]

Taken, subscribed and sworn to me before the undersigned authority in my said county, this 12th day of April, 1984.

Notary Public: Doris Galbraith

My Commission Expires: 5-27-87

CHAPTER II - Part UMC 782 - Requirements for Legal, Financial, Compliance, and Related Information

Scope

The objective of this chapter is to set forth all relevant information concerning ownership and control of Andalex Resources, Inc., the ownership and control of the property to be affected by mining activities and all other information and documentation required under Part UMC 782.

This addendum to the approved Mining and Reclamation Plan, permit identification number ACT/007/019, is merely for the incidental addition of a 120 acre federal lease to Andalexs current permit area. These reserves will be mined simply as an underground extension of the existing, approved, permitted and currently operating Pinnacle Mine. As such, no additional surface disturbances whatsoever are required. Access to and extraction and handling of all coal will be through existing facilities.

Legal, financial, and compliance information as required by Part UMC 782 and presented here is basically the same information presented in the approved plan. All required information is presented here once again; however in an updated form.

UMC 782.13 Identification of Interests

a) Permit Applicant

Andalex Resources, Inc.
P.O. Box 902
Price, Utah 84501
(801) 637-5385

b) Legal and Equitable Owners of Record

There will be no additional surface facility construction. All existing facilities are located either on land owned by Zions Securities Corporation or on federal land. The addresses of these owners of record are as follow:

Bureau of Land Management
Utah State Office
136 East South Temple
Salt Lake City, Utah 84111

Zion Securities Corporation
10 East South Temple
Salt Lake City, Utah 84111

All coal to be mined on the 120 acre addition is owned by the federal government. Coal to be mined over the rest of the mine plan area is owned either by the federal government or by Zion Securities Corporation. The addresses of these owners of record are as follows:

Bureau of Land Management
Utah State Office
136 East South Temple
Salt Lake City, Utah 84111

Zion Securities Corporation
10 East South Temple
Salt Lake City, Utah 84111

c) Purchasers of Record under Real Estate Contracts

There are no purchasers of record under any real estate contracts of areas to be affected by surface operations and facilities of this mine plan and there are no purchasers of record under any real estate contracts of the coal to be mined.

d) Operator

Andalex Resources, Inc.
P.O. Box 902
Price, Utah 84501
(801) 637-5385

e) Resident Agent of Applicant

C.T. Corporation System
175 South Main
Salt Lake City, Utah 84111

f) Business Entity Statement

The applicant, Andalex Resources, Inc., is a corporation organized and existing under the laws of Delaware and qualified to do business in Utah.

g) Officers, Partners and Directors

Officers:

Robert Anderson, Jr.	President
Dennis L. Halliburton	Vice President/Finance
Keith Smith	Vice President/Marketing
Kenneth Taylor	Vice President/Operations

Directors:

Mary-Jean Mitchell Green	Chairman of the Board of Directors
Robert Anderson, Jr.	Director
Dennis L. Halliburton	Director
M.I. Mair	Director
George D. Coates	Director

The address for all of the above is:

Andalex Resources, Inc.
1201 Hurstbourne Place
9300 Shelbyville Road
Louisville, Kentucky 40223

h) Principal Shareholders

The capital stock of Andalex Resources, Inc., is 100 percent owned and controlled by Cada Am Holding N.V., whose address is as follows:

C/O Dr. J.A. Schiltkamp
10 A Kerkstratt
Curacao, Netherland Antilles

i) Other Operating Names

Other names under which the principal shareholder has or is operating coal mining activities in the United States within the last five years preceding the date of this application are listed below:

Don Bow Mine
Cimarron Coal Corporation
Badgett Mine Stripping Corporation
West Ken Coal Corporation
AMCA Processing, Inc.
AMCA Resources, Inc.

j) Single Proprietor

Andalex Resources, Inc., holds the exclusive coal operating interests in the permit area.

k) Current or Previous Coal Mining Permits

A list of current and previous coal mining permits held by the principal shareholder is included in Appendix A.

l) Owners of Record of Surface and Subsurface Contiguous Areas

Names and addresses of all owners of record for all surface and subsurface areas contiguous to the permit area are listed below and indicated on Plates II and III.

Subsurface Owners

Franklin Real Estate Company (American Electric Power)
#2 Broadway
New York, New York

Sunedco Coal Company
7401 West Mansfield Avenue
Suite 418
P.O. Box 35-B
Lakewood, Colorado 80235

Bureau of Land Management
Utah State Office
Salt Lake City, Utah 84111

State of Utah
Division of State Lands & Forestry
3 Triad Center, Suite 400
Salt Lake City, Utah 84180

Surface Owners

Bureau of Land Management
Utah State Office
136 East South Temple
Salt Lake City, Utah 84111

Gladys R. Artman
P.O. Box 1200
Lakeland, Florida 33802

F. and D. Shimmin
711 North 5th East
Price, Utah 84501

Sunedco Coal Company
7401 West Mansfield Avenue
Suite 418
P.O. Box 35-B
Lakewood, Colorado 80235

R. and E. Nelson
583 Sundial Drive
Moab, Utah 84532

D. Mathis
Sunnyside Star Route
Price, Utah 84501

J & S Critchlow
144 South 1650 East
Price, Utah 84501

State of Utah
Division of State Lands & Forestry
3 Triad Center, Suite 400
Salt Lake City, Utah 84180

m) Mine Name and MSHA Identification

The Centennial Project includes the development of three separate mines. Two of these mines are currently in operation. The names and M.S.H.A. I.D. numbers for these existing mines and all sections are as follow:

Pinnacle Mine - M.S.H.A. I.D. #42-01474
Apex Mine - M.S.H.A. I.D. #42-01750

The third mine is at this time only proposed and has yet to be named or given an M.S.H.A. I.D. number. All coal from the 120 acre emergency lease for which this addendum is being submitted will be mined simply as an underground extension of the existing Pinnacle Mine.

n) Interests in Contiguous Lands

Andalex Resources, Inc., has formally submitted an expression of leasing interest for a 328 acre coal tract for consideration as part of the Uinta-Southwestern Utah Coal Region, coal lease sale offerings. This tract, known as the Graves tract, contains 327.58 acres and can be described as follows:

Township 13 South, Range 11 East, S.L.B.&M.
Section 1: SE¼, S½NW¼
Section 12: NE¼NE¼

Township 12 South, Range 11 East, S.L.B.&M.
Section 31: SW¼SW¼ (lots 6,22)

Other than this tract and Rights-of-Way granted by the Bureau of Land Management Andalex Resources has no interests in lands, options or pending bids for lands which are contiguous to the permit area.

UMC 782.14 Compliance Information

a) Suspension and Revocation

Andalex Resources, Inc., affiliates or persons controlled by or under common control with Andalex haven't had a mining permit suspended or revoked within the last five years.

b) Forfeiture of Bond

Andalex Resources, Inc., affiliates or persons controlled by or under common control with Tower have not forfeited a mining bond or similar security in lieu of bond.

c) History of Violations

Appendix B contains a listing of all violations received within the last three years prior to the date of this application by Andalex and affiliated companies.

UMC 782.15 Right of Entry and Operation Information

Andalex Resoures, Inc., in sublease agreement with AMCA Coal Leasing, Inc., currently holds 2,798.35 acres of private and federal coal leases in this permit area. Andalexbasis its legal right to enter and conduct mining activities in the permit area pursuant to the language contained in the Federal Coal Leases, Section 2, Rights of Lessee as follows:

> "The lessor, in consideration of any bonus paid (or to be paid if deferred), rents and royalties and other conditions hereinafter set forth, hereby grants and leases to the lessee the exclusive right and privilege to mine and dispose of all coal... subject to the conditions, limitations and prohibitions provided in this lease and in applicable acts and regulations, the right to construct all works, buildings, structures, equipment, and appliances which may be necessary and convenient for the mining and preparation of the coal for market, and subject to the conditions herein provided, to use so much of the surface as may reasonably be required in the exercise of the rights and privileges herein granted..."

A similar right to enter and conduct underground mining activities is contained in the private lease agreement with the Zion Securities Corporation as follows:

> "During the life of the lease, so long as lessee is not in default hereunder, it may freely prospect, mine and develop the lease premises, extract and sell such coal thereform as it may elect, and use the surface and underground thereof for all lawful purposes including the exploration and mining to be conducted therein and thereon. It may also use the leased lands in connection with the mining and development of other lands which it may own, lease, or acquire as a part of its general mining operations in the area."

The Federal Coal Leases are described as follows:

SL-027304:

Tract 1: T.13S., R.11E., SLM, Utah
Sec. 7, S½SE¼,
Sec. 18, NW¼NE¼.

Tract 2: T.13S., R.11E., SLM, Utah (lease modification not part of this MRP)
Sec. 6, lot 4;
Sec. 18, lot 1, N½NE¼NW¼, SW½NE¼NW¼

containing 235.96 acres, more or less.

This lease was originally assigned to W.F. Olsen on September 1, 1925. On May 1, 1959, the lease was assigned to F.H. Larson and then to Centennial Coal Associates on February 1, 1973. AMCA Coal Leasing, Inc., acquired the lease in February, 1977 and subsequently added Tract 2 through lease modification criteria on October 26, 1981.

SL-063058:

Tract 1: T.13S., R.11E., SLM, Utah
Sec. 8, S¼SW¼;
Sec. 17, N½NW¼, SE¼NW¼;
Sec. 18, NE¼NE¼.

Tract 2: T.13S., R.11E., SLM, Utah (lease modification not part of this MRP)
Sec. 17, SW¼NW¼, SE¼NW½SW¼, W½NW¼SW¼,
Sec. 18, E½SE¼NE¼, NW¼SE¼NE¼, SW¼NE¼,
E½NE¼SE¼.

containing 400 acres, more or less.

The original lease of 80 acres was assigned to C.D. Sutton on August 3, 1942. On July 27, 1950, the lease was amended to embrace 200 acres. An additional 40 acres was added December 13, 1951. The leases were posted to F.H. Larson on May 1, 1970 and then to Centennial Coal Associates on February 1, 1973. AMCA Coal Leasing, Inc., acquired the lease in February, 1977 and subsequently added Tract 2 through the Federal lease modification criteria.

U-010581:

Tract 1: T.13S., R.11E., SLM, Utah
Secs. 5, and 6, all;
Sec. 7, lot 1 NE¼, NE¼NW¼, N½SE¼;
Sec. 8, N½, N½S½, S½SE¼;
Sec. 9, W½SW¼;
Sec. 17, N½NE¼.

Tract 2: T.13S., R.11E., SLM, Utah (lease modification not part of this MRP)
Sec. 17, S½NW¼, N½NE¼SW¼,
NE¼SE¼, N½NW¼SE¼

containing 1,842.39 acres, more or less.

This lease was assigned to C.D. Sutton on February 1, 1956. On May 1, 1970 the lease was assigned to F.H. Larson and then to Centennial Coal Associates on February 1, 1973. AMCA Coal Leasing, Inc., acquired the lease in February, 1977 and subsequently added Tract 2 through the federal lease modification criteria.

U-52341:

T.13S., R.11E., SLM, Utah
Sec. 9, E½SW¼, SW¼SE¼

containing 120 acres, more or less.

This lease was acquired by AMCA Coal Leasing, Inc., in November, 1983 through the emergency lease criteria.

The private fee lease is described as follows:

T.13S., R.11E., SLBM, Carbon County, Utah
Sec. 7: S½NW¼
N½SW¼
SE¼SW¼

containing 200 acres, more or less.

The name and address of the lessor is Zion Securities Corporation, 10 East South Temple Street, Salt Lake City, Utah. This lease was originally made and entered into between Zion's and Centennial Coal Associates on August 1, 1972. AMCA Coal Leasing, Inc., acquired the lease in February, 1977.

UMC 782.16 Relationship to Areas Designated Unsuitable for Mining

The permit area is not within an area designated unsuitable for the surface effects of underground coal mining activities under UMC 764 or under study for designation in an administrative proceeding initiated under those pasts. Further, there are no occupied dwellings within 300 feet of the permit area.

UMC 782.17 Permit Term Information

All coal will be mined simply as an underground extension of the existing Pinnacle Mine operation. The starting and termination dates as well as the horizontal and vertical extent of the proposed underground mining activities over the total life of the permit are indicated on the revised Pinnacle underground layout map included as Plate 30. Also refer to the underground layout maps for the Apex and Aberdeen Mines previously submitted.

The requested term of this permit is five years. Andalex will then apply for five year extensions over the life of the mine.

UMC 782.18 Personal Injury and Property Damage Information

Appendix E contains certificates of liability insurance covering personal injury and property damage resulting from this operation.

UMC 782.19 Identification of Other Licenses and Permits

The following is a list of all other licenses and permits under applicable State and Federal land-use, air and water quality, water rights and health and safety laws and regulations held by Andalex in order to conduct underground coal mining activities.

State:

1) State of Utah
   Department of Natural Resources
   Division of Oil, Gas and Mining
   4241 State Office Building
   Salt Lake City, Utah 84116

   - Mining and Reclamation Plan for Andalex Resources' Centennial Project
     Permit I.D. Number ACT/007/019
     Approved January 4, 1982

2) State of Utah
   Department of Health
   Division of Environmental Health
   150 West North Temple
   P.O. Box 2500
   Salt Lake City, Utah 84110

   - Air Quality Construction and Operation Permit
     Approved June 13, 1980

   - Water Quality - Sediment and Drainage
     Approved May 14, 1980

   - Septic and Culinary Plan (2)
     Approved September 17, 1980 (Office Site)
     Approved May 8, 1980 (Bathhouse Facility)

Federal:

1) Environmental Protection Agency
Region VIII
1860 Lincoln Street
Denver, Colorado 80295

- National Pollutant Discharge Elimination System (NPDES)
  Permit I.D. - UT-0023507
  Issued April 25, 1982

- Prevention of Significant Deterioration of Air Quality (PSD)
  Unissued: Determined by the E.P.A. to be unnecessary

2) Bureau of Land Management
Utah State Office
136 East South Temple
Salt Lake City, Utah 84111

- Access Road Right-of-Way
  Permit Number U-45966
  Granted September 1, 1980

- Buried Telephone Cable Right-of-Way
  Permit Number U-36739
  Granted November 20, 1978

- Power Transmission Line Right-of-Way
  Permit Number U-36741
  Granted November 20, 1978

- Material Storage Site Right-of-Way
  Permit Number U-45965
  Granted September 11, 1980

3) Mine Safety and Health Administration (M.S.H.A.)
P.O. Box 25367
Denver, Colorado 80225
(District 9)
Pinnacle Mine I.D. 42-01474
Apex Mine I.D. 42-01750

- Roof Control Plan
  Reviewed and approved every six months

- Ventilation System and Methane and Dust Control Plan
  Reviewed and approved every six months

- Fan Stoppage Plan
  Approved September 21, 1978

- Smoking Prohibition Plan
  Approved September 21, 1978

- Training Plan
  Approved August 19, 1980

- Instruction Program: Firefighting and Evacuation Plan
  Approved November 5, 1980

- Medical Program
  Approved September 6, 1978

UMC 782.20 Identification of Location of Public Office for Filing of Application

A copy of this addendum will be filed simultaneously for public inspection with the County Recorder of Carbon County, Carbon County Courthouse, Price, Utah.

UMC 782.21 Newspaper Advertisement and Proof of Publication

A copy of the newspaper advertisement of this addendum and proof of publication of the advertisement will be filed with the Division and made part of the complete application not later than 4 weeks after the last date of publication.

Salt Lake and Intermountain Area Obituaries

Lois R. Frederick

Lois R. Frederick, 62, of Salt Lake City, died December [illegible], 1978. Born January [illegible], 1916, Cissna Park, Illinois to Dr. and Mrs. William Ross and Jennie Leatherman Roberts. Married Philip R. Frederick, M.D. August 13, 1949 in Salt Lake City. Graduated Illinois Wesleyan University, member Alpha Gamma Delta Sorority and served as its president 1934 [illegible]. 1938 Chief Radiological Technologist at the L.D.S. Hospital 1949 thru 1951, taught radiological technology at L.D.S. Hospital and University of Utah. Author of Radiological Technic Manual 1952. Multiple offices in League of Women Voters. Appointed to the Air Conservation Committee by Gov. Rampton when it was established in 1967 and elected as its chairman for 10 years. Pilot with commercial license and multiengine and instrument ratings. Member Women's Legislative Council.

Survivors: husband, Dr. Philip R. Frederick; daughter, Carolyn J. Frederick, both Salt Lake City; sister, Mrs. Dwight B. Leigh, East Lynn, Illinois; brothers, Dr. Joseph Roberts, Paul Roberts, both Watseka, Illinois. Memorial services will be held Thursday 12:00 noon, Larkin Mortuary Chapel. In lieu of flowers family suggests donations to the L.D.S. Hospital Deseret Foundation for Education and Research.

Joseph Henry (Joe) Dansie

Joseph Henry Dansie (Joe), beloved father, grandfather and brother, 85, of 235 Coatsville Avenue, died Saturday, December 16, 1978 of complications following surgery at a Murray hospital.

Born March 23, 1893, Riverton, Utah, to Robert and Anne Christine Madsen Dansie. Married Ruth Evelyn Huppert, August 14, 1964, Kingman, Arizona. She died May 27, 1977.

An ironmolder and foundryman by trade, he served as President (1920) and Vice President (1921) of the International Molders and Allied Workers Union, Local 221. He was involved in the construction trade (cement finisher) and worked for several building firms, including Lresidor Construction Co. In later years he worked as a gardener at the Covey Apartments. He was a member of several fraternal organizations. An avid family historian and [illegible], he was instrumental in locating the gravesite of his grandfather who died in [illegible] coming to Utah. He later became Chairman of Charlotte [illegible] Dansie Memorial Association which erected a monument in his memory. [illegible]

Phyllis Jane Parks Clouner Campbell

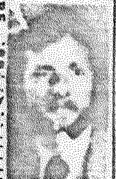
Phyllis Jane Parks Clouner Campbell, 64, Cleveland, Ohio, died Dec. 12, 1978 in a Salt Lake hospital.

Born Nov. 18, 1914, Smithfield, Ohio to William George and Marguerite Jane Ford Parks. Married Charles Clouner, July 31, 1939, later divorced. Married Joseph Campbell, October 1972. He preceded her in death. Member United Methodist Church, Palestine Shrine No. 2, Order of Amaranth, Euclid Order No. 35, Eastern Star Friendship Chapter 2, all in Cleveland.

Survivors: father, Buckeye, [illegible]; daughter, Mrs. Ronald (Barbara L.) Miller, Salt Lake City; seven grandchildren; two brothers, Don Parks, Atwater, Calif.; Ford Parks, Naples, Fla.

Funeral services Thursday, 11 a.m., Memorial Estates Mortuary, 5850 So. 900 East, where friends may call one-half hour prior to services. Interment, Mountain View Memorial Estates.

Mathew J. Harris



Mathew J. Harris, 29, 1333 Princeton Ave., formerly of Tremonton, died Dec. 18, 1978, in Salt Lake City.

Born May 21, 1949, Salt Lake City, to Jay Dee and Alice Christopherson Harris. Married Mary Elaine Naylor, Aug. 16, 1975, Salt Lake City. Reared and educated in Tremonton, attended Bear River High School, graduate of Garland LDS Seminary. Lived in Tremonton, moved to Salt Lake City, September 1978. President of Harris Trucking Equipment, Tremonton, Phoenix, and Albuquerque, N.M.

Surviving: wife, Mary, Salt Lake City; 2 sons and daughter, Zachary Joel, 7, Ogden; Nathaniel A., 1, Rachel Anne, 2, both Salt Lake; parents, Tremonton; sister, Mrs. Lynn (Christy) Richards, Fielding, Utah.

Funeral services Friday 1 p.m. at Tremonton 4th LDS Ward Chapel. Friends call at Rogers Mortuary at Tremonton, 1st N. 1st East, Thursday 6-8 p.m. and Friday 11 a.m.-12:30 p.m. Burial, Tremonton Riverview Cemetery.

Margaret (Marnie) Cross

Margaret Frances Goodman White Cross, 7[illegible], of Salt Lake City, Utah, died December 17, 1978.

Born October 16, 1903, Colorado, [illegible] [illegible]

Elizabeth Medley Stevenson

Elizabeth Medley Stevenson, age 60, passed away December 18, 1978 in North Ridge, California.

Born December 23, 1917 in Salt Lake City, Utah to Grover C. and Lina Muller Medley. Married William Stevenson June 5, 1943; he preceded her in death. She was raised in the Salt Lake 19th Ward, a graduate of West High School, worked at Walgreens 20 years and Paris Company 8 years.

Survivors: brother, Grover Medley; sister, Mrs. Kenneth M. McNabb, with whom she lived; 2 nieces and 3 nephews.

Funeral services Thursday 2:00 p.m. at the Deseret Mortuary, 36 East 700 South, where friends may call Wednesday 6-8 p.m. and Thursday one hour prior to services. Interment Salt Lake City Cemetery.

Eva Harriet Massey Harper

Our beloved mother and grandmother, Eva Harriet Massey Harper, died December 19, 1978, at Meadow View Nursing Home in Murray, Utah.

She was born in Fargo, North Dakota, on April 2, 1890, a daughter of Nathaniel G. and Harriet J. Fritz Massey. Married LeRoy Harper on April 28, 1918, in Boise, Idaho; he died April 27, 1973. She was top saleslady for Northern Oil and Utah Hydro-Flame Corporation for 30 years. Member of Eastern Star, member of Wasatch Presbyterian Church.

Survived by sons, Frank L., LaVerne, California; Rolland E., Kearns, Utah; 4 grandchildren and 6 great-grandchildren.

Funeral services will be held Thursday, 12:00 noon, at Wasatch Presbyterian Church, 1626 South 1700 East; friends may call at the Colonial Mortuary, 2128 South State, Wednesday, 6-8 p.m., and at the Church Thursday, 1 hour prior to services. Interment, Elysian Burial Gardens.

Richard Dean Christensen

Richard Dean Christensen, age 29, of Taylorsville, died December 19, 1978, in a Cottonwood Hospital.

Born October 16, 1949, in Salt Lake City, Utah, to Albert L. Christensen and Edna E. Cushing. Married Marsha Anne [illegible] November 9, 1968, in Salt Lake City [illegible]

Raymond Lewis Smith

Raymond Lewis Smith, age 59, of Salt Lake City, died December 18, 1978 in a local hospital.

Born May 19, 1919, in Eureka, Utah, to Arthur and Amnie Bruce Smith. Married Thelma Pearl September 17, 1941, Malad, Idaho. Veteran of U.S. Army, World War II. Meat Cutter for past 32 years.

Survivors: wife; son, Thomas R. Smith, Salt Lake City; 2 grandchildren; brother, Frank Smith, of Salt Lake; sister, Mrs. Edna Jasper, of Eureka, Utah. Funeral services will be Thursday, 10 a.m., Larkin Mortuary, 260 East South Temple. Interment, Goshen City Cemetery.

Family suggest contributions may be made to Utah Heart Association.

005 FUNERAL NOTICES

MOYLE — Funeral services for Helen Rich Moyle will be held Thursday, 2 p.m. in the Larkin Mortuary Chapel, 260 East South Temple. Interment: Salt Lake City Cemetery. Funeral directors: Larkin Mortuary.

Legal Notices

ADVERTISEMENT FOR BIDS

Granger-Hunter Improvement District, 3146 West 3500 South, Salt Lake City, Utah 84119

Separate sealed BIDS for the construction of "Construction of 3.0 M.G. Steel Tank at Sewage Treatment Plant — Section 264" will be received by Granger-Hunter Improvement District at the office of the District at 3146 West 3500 South, Salt Lake City, Utah until 10:00 a.m. (Standard Time) December 28, 1978, and then at said office publicly opened and read aloud.

The CONTRACT DOCUMENTS may be examined at the following locations:

Granger-Hunter Improvement District, 3146 West 3500 South, Salt Lake City, Utah;

Templeton, Linke & Associates, 40 West 2950 South, Salt Lake City, Utah.

Copies of the CONTRACT DOCUMENTS may be obtained at the office of Templeton, Linke & Associates located at 40 West 2950 South, Salt Lake City, Utah upon payment of $20.00 for each set.

Any BIDDER submitting a complete bid on the project, upon returning such set within 30 days of bid opening and in good condition, will be refunded his deposit for one set of documents. Any NON-BIDDER, or BIDDER with additional sets will be refunded $10.00 of his deposit for each set returned in good condition within 30 days of the bid opening.

December 11, 1978

GERALD L. LARSON
Manager

(B-15)

ADVERTISEMENT FOR BIDS

Granger-Hunter Improvement District, 3146 West 3500 South, Salt Lake City, Utah [illegible]

[illegible]

ORDER TO SHOW CAUSE
No. ACT/007/011

BEFORE THE BOARD OF OIL, GAS AND MINING, DEPARTMENT OF NATURAL RESOURCES in and for the STATE OF UTAH

IN THE MATTER OF THE APPROVAL OF THE NOTICE OF INTENT AND RECLAMATION PLAN SUBMITTED BY AMCA COAL LEASING, INC., P.O. Box 1027, Price, Utah 84501

THE STATE OF UTAH TO ALL OPERATORS, TAKERS OF PRODUCTION, MINERAL AND ROYALTY OWNERS, AND PARTICULARLY ALL PERSONS INTERESTED IN TOWNSHIP 13 SOUTH, RANGE 11 EAST, CARBON COUNTY, UTAH

Notice is hereby given that tentative approval was given by the Utah Division of Oil, Gas, and Mining, to AMCA Coal Leasing, Inc., P.O. Box 1027, Price, Utah 84501, to commence Underground Room and Pillar Coal mining on Section 7, Township 13 South, Range 11 East, Carbon County, Utah. The name of the proposed mine is the Centennial Project — Zions Fee, and the person representing the company is Mr. Samuel C. Quigley, P.O. Box 1027, Price, Utah 84501.

AMCA Coal Leasing, Inc. has fulfilled obligations under the Utah Mined Land Reclamation Act of 1975 (Section 40-8, U.C.A., 1953, as amended) and all applicable rules and regulations, and will employ the following reclamation and development techniques on 6 acres of Fee-owned surface acreage.

Before Operations

1. Plans shall be finalized for dams for sedimentation ponds or impoundments.

2. Said plans shall provide for construction and compliance standards in accordance with Rule MC-717.17 and shall be approved by a registered professional engineer as to their compliance with this rule.

3. Mining will be conducted in a safe and orderly manner.

4. Coal and waste rock will be placed in designated areas.

5. Soil will be stockpiled and stabilized for reclamation purposes following mining.

After Operations

1. Construction of the ponds or impoundments shall be inspected by and certified after construction by a registered professional engineer.

2. All buildings, machinery and debris will be removed or buried.

3. All shafts and mine vents will be properly sealed to prevent unauthorized entry.

4. Waste pads and dumps will be reclaimed in accordance with Rule MC-717.14.

5. All disturbed areas will be scarified, fertilized, and revegetated with a grass-shrub mixture.

Reclamation surety will be held by the Utah Division of Oil, Gas, and Mining.

Any person or agency aggrieved by this tentative decision is hereby requested to submit written protest within 30 days of December 21, 1978, to the Division of Oil, Gas, and Mining, 1588 West North Temple, Salt Lake City, Utah 84116, setting forth factual reasons for his complaint, and thereafter at a time and place hereafter established, appear before the Board of Oil, Gas, and Mining, to show cause, if any there be, why this plan should not be approved.

STATE OF UTAH
BOARD OF OIL, GAS AND MINING
SCHEREE WILCOX
(B-14) Secretary of the Board

NOTICE TO CONTRACTORS

Sealed bids will be received by the UTAH STATE BUILDING BOARD for [illegible] LAKE STATE [illegible] DEVELOPMENT [illegible]

[illegible]

The CONTRACT DOCUMENTS may be examined at [illegible]

[illegible]

NOTICE OF HEARING
Case No. 78-467-01

BEFORE THE PUBLIC SERVICE COMMISSION OF UTAH

In the Matter of the Application of ROADWAY EXPRESS, INC. for a Certificate of Convenience and Necessity to operate as a common motor carrier of property in intrastate commerce (To assume the operating rights of Western Gillette, Inc., Cert. No. 1050, Case No. 3915.)

Notice is hereby given that the above-entitled matter will be heard before the Public Service Commission of Utah on Wednesday, the 27th day of December, 1978, at 10:00 a.m. at the Commission hearing room, 330 East 400 South, Salt Lake City, Utah.

Applicant proposes to assume the operating authority of Western Gillette, Inc., as evidenced by Certificate of Convenience [illegible] No. 1050, issued in [illegible] as follows:

[illegible] common carrier by motor vehicle for the transportation of petroleum and petroleum products, except road oil [illegible] asphalt, in bulk, and also to transport benzol in bulk, in tank trucks and trailers, over irregular routes between all points and places within the State of Utah, excluding Uintah County as an origin point except when destination from Uintah County is either Salt Lake City, City or Woods Cross, Utah; and between Geneva and Ironton, Utah, on the one hand and Salt Lake City, Utah and Woods Cross, Utah on the other, over all highways within the State of Utah.

By Order of the Commission.

DATED at Salt Lake City, Utah this 15th day of December, 1978.

VICTOR N. GIBB,
Secretary

Attorney of Record:
MARK K. BOYLE
10 West Broadway, #400
Salt Lake City,
Utah 84101

(B-22)

PUBLIC MEETING

Pursuant to Public Law 93-641, notice is herewith made that the Copper Mountain Mental Health Center is proposing to apply for Federal Funds in the amount of $89,500. The proposal is to continue delivery of the Consultation and Education program through the Center.

This grant proposal was received in the Utah HSA offices on December 11, 1978, on which the 60-Day Review Cycle began. The proposal will be considered and recommendations made at the following public meeting:

Utah Health Program Review Advisory Committee, Friday, January 12, 1979 — 8:30 a.m., Hotel Utah Motor Inn, "William Mason" Meeting Room, 125 West North Temple, Salt Lake City, Utah.

Any individual or group wishing to present comments, ask questions, or register complaints are welcome to attend this meeting. Interested persons may formally request (in writing) a public hearing on the proposal no later than January 2, 1979. Any questions regarding this federal grant request should be directed to Jean Holtinger at the Utah Health Systems Agency (801) 581-3476.

(B-9)

SALT LAKE COUNTY INVITATION TO BID

Bids will be received by the Purchasing Department of Salt Lake County as follows:

Lease #193, 11:30 a.m., December 27, 1978 — Mexica Metal Pipe

Specifications may be obtained from County Purchasing, 151 East 21st South, Bldg. B, Third Floor.

The County Commission reserves the right to reject any or all bids. [illegible]

[illegible]
Purchasing Agent

(B-8)

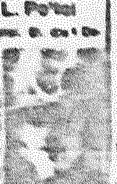
NOTICE OF APPLICATIONS

[illegible]

006—Lost and Found

[illegible]

William L. Patel



[illegible]

Urvie Gee

[illegible]

Martha Ellen Cornwall Wade

[illegible]

III. Operation and Reclamation Plan

A. Overview of Project

1. Type of Mine

The initial underground mining operation known as the Pinnacle Mine, located on the Zion's fee property, began production on October 3, 1980. It consists of a single unit's production with an output projected to be approximately 200,000 tons per year and with 20 employees. Upon approval of this permit application, the mine will move onto the Federal leases and expand to two or three units with an annual production of approximately 500,000 tons. As there are three mineable seams present, the Aberdeen, Gilson, and Lower Sunnyside, in ascending order, mining plans call for simultaneous operation of a mine in each seam. The existing operation is in the Gilson seam.

Mining will consist of the underground method of coal extraction using continuous miners, shuttle cars, and conveyor haulage. Room and pillar development will be employed with final extraction estimated to be about 65 percent of the reserve, after pillar extraction.

Coal is presently being loaded into 40 ton coal trucks and hauled to Wildcat Jct. on the Utah Railroad.

2. Area of Operations

2.1 Mine Plan Area

The mine plan area is limited to and contained within the proposed permit area. Mine plans for each of the mineable seams are included as Plates 29, 30 and 31.

2.2 Proposed Permit Area

The proposed permit area consists of three Federal leases and one fee lease, all controlled by Andalex Resources. Presently, mining operations are taking place on Tower's Zion fee lease. Federal leases are U-010581, SL-27304, and SL-063058. These leases are shown on Plate 4. Note that lease modifications are not part of this MRP.

2.3 Surface Area to be Disturbed

Surface disturbances are and will be minimal due to the nature of the mining activities. The proposed permit area has been previously impacted by mining. Surface disturbances will be limited to the existing facilities which have been constructed on the Zion's fee area and the new facilities will be located in previously disturbed areas. The total existing surface area disturbed is approximately 33 acres. Proposed facilities are indicated on Plates 6 and 7.

3. Reserves, Production, and Life of Mine

Total reserves of all three seams (in place) are estimated at 50 million tons, of which 29 million tons is expected recoverable.

Production schedule estimates 200,000 tons during the first year of operation. This will be systematically increased to approximately 1 million tons in the fourth or fifth year.

If the extraction rate of 1 million tons is accomplished according to schedule, the project life will be about 28 years. The theoretical life is closer to 40 years however due to the existence of unleased Federal coal logically accessible through only the existing and future Andalex mine workings.

4. Schedule of Construction, Mine Development, Mining and Reclamation

All surface facilities have been constructed for the Pinnacle Mine. Mining in the Gilson seam began in October, 1980 with a single unit's production. As mining progresses, additional units will be added with 5 production units scheduled to be operating by February 1985. A systematic mining plan will be followed to assure maximum recovery. All planning and scheduled production, however, will be contingent upon the coal market and approval of this permit application. Upon the conclusion of mining activities in the area, the scheduled reclamation phase will begin immediately. Refer to Part E of this Chapter re Reclamation.

B. Construction and Design of Surface Facilities

1. Existing Structures

All existing structures are situated on the Zion's fee land or on Federal lease SL-027304 within BLM ROW U-45966 and are shown on Plates 6 and 7. All structures are complete and include the following:

Bathhouse	14' x 60'
Mine Water Storage Tanks	12' x 16'
Warehouse	14' x 60'
Superintendent's Office	16' x 70'
Substation	60' x 100'
Office Building	28' x 60'
Mine Fan	88"
Portals	6' x 20' (4 ea.)
Culinary Water Tanks	12' x 10'
Sediment Ponds	.737 acres

Upon completion of mining activities, the portals will be sealed according to existing state and Federal regulations and all buildings and structures not being utilized as part of the reclamation sequence, will be removed, according to the Reclamation Plan outlined in Part E of this Chapter.

2. Construction Schedule

All of the above structures have been completed. Additional construction of structures or facilities including additional warehouse and shop facilities, is anticipated for the existing mine (Pinnacle Mine). Construction has been located and carried out so as to prevent and control erosion, siltation, water pollution, and damage to property. All facilities have been designed and constructed and will be maintained and used in a manner which prevents damage to wildlife and related environmental values. Any future construction will be conducted in a similar manner according to regulations regarding protection of the hydrologic system, etc. All additional structures to be located on the Zion's fee have been approved by DOGM.

3. Construction Methods

3.1 Major Equipment

The portal and building sites were leveled using dozers, trucks, and loaders. At the building sites, the topsoil was removed and transported to a nearby area for storage.

All surface pads have been graveled and all other disturbed areas (pond embankments, etc.) have been reseeded according to recommendations by the U.S. Department of Agriculture, Soil Conservation Service.

3.2 Blasting

All surface blasting activities necessary for present operations have been completed in compliance with sections 817.61 through 817.68 of Chapter VIII of Title 30 of the Code of Federal Regulations. Blasting consisted of portal highwall construction for purposes of stability. Future surface blasting, if necessary, would be very limited and would consist of highwall preparation for similar portal facilities.

4. Removal and Storage of Topsoil and Subsoils

The area from which topsoil was removed is approximately 30 acres and includes poorly developed soils. Using dozers and front end loaders, the soil was scraped from the surface and dumped at a site on facility location. The topsoil storage areas is shown on Plate 6 . The topsoil was removed as a separate operation from areas to be disturbed by surface installations, such as roads and areas upon which support facilities are sited. Topsoil has been segregated, stockpiled, and protected from wind and water erosion and contaminants through revegetation. Disturbed areas no longer required for the conduct of mining operations have been graded and revegetated. Once the topsoil was removed, the canyon bottom was leveled and culverts installed to prepare the area for building construction. For further information about topsoil see Chapter IV, Part F re Soil Resources.

5. Portal Facilities (See Plate 6)

5.1 Mine Pads

The portal mine pad consists of approximately .922 acres. Located on this pad are the fan, conveyor portal, air intake portals, mine water storage tank, warehouse and superintendents office.

5.2 Support Structures and Buildings

Support structures and buildings are listed in Part B, Section 1 of this chapter and shown on Plate 6.

5.3 Parking Areas

Parking lots have been covered with gravel and magnesium chloride and will be maintained. These are shown on Plate 6.

5.4 Storage Areas

There are several storage areas at the site. These include: Material Storage Area No. 1 (1.482 acres), Raw Coal Pile Area (1.393 acres), Material Storage Area No. 2 (1.075 acres), and the Topsoil Storage Area (.0638 acres). The bathhouse and parking area and a water storage tank are located on Material Storage Area No. 2. All areas are shown on Plate 6. B.L.M. ROW U-45965 has also been designated a material storage area as well as an office site and parking area.

6. Coal Handling Facilities

6.1 Conveyors

Coal is discharged from a shuttle car onto a conveyor belt for transportation to the outside. Location of this conveyor is shown on Plate 6.

6.2 Stockpiles

Coal is discharged from the conveyor onto a coal stockpile in the Raw Coal Stockpile Area indicated on Plate 6. This is a live stockpile as opposed to a storage pile.

6.3 Loadout

Coal is loaded from the stockpile by an electronic automatic loadout into 40 ton coal trucks and hauled to various sidings on the Utah Railroad.

6.4 Preparation Plant

Depending on the coal market in the future, a preparation plant (wash plant) may be used. However, it is not anticipated.

7. Transportation Facilities

7.1 Roads

7.1-1 Class I

The previously existing road, which runs approximately 10 miles from Price, Utah to the Zion's fee area, can be classified hard surfaced secondary highway. The road was an existing county road and has been upgraded with new surface gravel, culverts, and drainage ditches. The grade of this road ranges from less than 1 percent to approximately 5 percent in the canyon areas. At no time does this road exceed 10 percent grade hence minimizing erosion and other effects on the hydrologic system.

During its life, this road will be constantly maintained. All necessary repairs will be made in a timely manner. The road has been paved to control dust. In winter months, snow will be removed, the road graded and kept open. Signs have been posted at strategic points along the road to warn of any possible hazards which might exist.

This road is shown on Plate 1 and is presently being used as both an access road and a haul road.

7.1-2 Class II

The above described road is the only road presently being used in association with mining activities.

7.1-3 Class III

The above described road is the only road presently being used in association with mining activities.

7.2 Railroad

There are no existing or proposed railroad spurs on the property.

8. Dams, Embankments, Ponds, and Other Impoundments

Three sedimentation ponds have been constructed so far as shown on Plate 6. A copy of the "Sedimentation and Drainage Control Plan" according to which the ponds were constructed is attached as Exhibit III-A. The sedimentation and drainage control plan has been designed according to OSM regulations and the design and construction certified by a Utah Registered Professional Engineer. No other embankments, or other impoundments have been built nor are any proposed excepting similar sedimentation control structures at new surface facility sites.

9. Power Supply and Communication Facilities

A 4160 volt, 3 phase, 60 hertz power distribution system has been taken underground from a 2500 KW substation located on the surface plant area. The primary feed into the substation is 46,000 volts from the Utah Power and Light Company transmission system located approximately 6 miles south, adjacent to the airport. This 46 KV line taps Utah Power and Light's Helper - Columbia 46 KV line, at structure #89. The power line was designed according to Utah Power and Light's specifications. After approval by Utah Power and Light, it was installed by a private local contractor at the expense of Andalex Resources. Within the mine site area, the power is reduced to 4160 volts for the primary underground usage. This is fracture reduced to 480 volts for equipment operation. Surface power is on a 480 volt system. Electrical Specifications for the

Deadman Canyon Mine Substation are included as Appendix I.

A 25 pair telephone communications cable is buried along the existing Deadman Canyon road, with its origin at Carbon County Airport approximately 7.5 miles from the minesite. Currently, 8 pairs are in use with additional capacity to add as the mine facilities expand. This cable was designed, supplied and installed by Mountain Bell telephone at the expense of Andalex Resources.

10. Solid-Waste Disposal and Handling Facilities

10.1 Underground Development Waste and Excess Spoil

There has been no development waste or excess spoil and there will be none.

10.2 Coal Waste

10.2-1 Coal Processing Waste

As coal is hauled from the area in the form of raw coal, there is no processing waste.

10.2-2 Coal Refuse

As stated above, the raw coal is hauled from the area, therefore, there is no coal refuse.

10.3 Acid and Toxic-Forming Materials

Because there is no refuse of any kind, there will be no acid or toxic-forming materials deposited or stored in the area.

10.4 Non-Coal Waste

During the construction of the minesite facilities, a small amount of cuts were made in forming pads and access, etc. As is outlined in the approved Mining & Reclamation Plan, all cut material was used in fill situations, therefore, there was no disposal of non coal material in the form of waste.

11. Water Supply

Water for use in the mine is from Water Well No. 1 and stored in the Mine Water Tank as shown on Plate VI . Water for culinary use will be from Water Well No. 2 or proposed Water Well No. 4 and stored in the Water Tank on the Material Storage Area No. 2. This is also shown on Plate VI .

Also, Water Well No. 3 shown on Plate VI will be utilized if the need arises. There will also be a sump cut in the mine from which water can be reclaimed as all available water will be needed. Since all mining is down dip from the portals, no water will exit from the mine. Information concerning the wells and water analysis is presented as Appendix H.

12. Hydrologic Protection Facilities

12.1 Sewage System

The nature of the overburden in the area offers excellent drainage. As a result, a septic system with drain fields conforming to the state codes has been established to handle the waste water disposal from the bathhouse and office facilities. Enclosed as Exhibit III-D are the two septic system plans as designed by a Utah Registered Professional Engineer and approved by the State of Utah Department of Health.

12.2 Water Treatment

Based on the State of Utah, Department of Health review of the septic systems, water treatment is not needed. (Personal communication, Mr. Gerald Story, Utah Department of Health, Price, Utah).

12.3 Drainage Control - Diversions, etc.

The drainage control plan is presented as Appendix L.

12.4 Sediment Control

The sedimentation plan is presented as Appendix L & Page 166.

13. Exploration and Development Drill Sites

A five hole drilling program was conducted by Centennial Coal Associates in 1971. A seven hole drilling program was conducted by Tower in 1977. These programs were supplemented by mine samples, outcrop information, and information obtained from two holes drilled west of the property by North American Coal Company in 1948. All drill sites are shown on Plates 26, 27 and 28. Refer to Chapter IV, Part A, Section 3.2-2.2 re Data.

14. Monitoring Facilities

14.1 Subsidence

Subsidence monitoring facilities will be set up with provisions for regular inspection and recordation of data as technology dictates.

14.2 Hydrologic

Water quality monitoring stations will be set up at the wells as shown on Plate 6 and also at the sedimentation pond discharge structures. Refer to Chapter IV, Part B, Section 4.4 re Monitoring.

14.3 Other

No other monitoring facilities are anticipated at this time.

15. Landscaping

All disturbed areas have been graded to the most moderate slope possible to assure stability. Vegetative cover has been promptly re-established to stabilize erosion. Revegetation was accomplished by Andalex under the recommendations of the U.S. Department of Agriculture, Soil Conservation Service.

16. Signs, Markers, Fences, and Gates

Signs of a uniform design, showing the company name, business address, and telephone number as well as the identification number of the current regulatory program permit authorizing the underground mining activities, have been placed at all access points to the permit area. These signs have been placed to be easily seen, are made of a durable material, and conform to local laws and regulations. The topsoil storage areas is clearly marked.

As this is an underground mine, there will be no blasting conducted on the surface with the exception of highwall construction. When blasting for highwall construction does occur, conspicuous signs and flagging will be posted as required by 30 CFR Parts 817.11 (f) and 817.65 (e).

As there are no perennial streams or a stream with a biological community on the permit area, buffer zone markers will not be necessary. The perimeters of all areas affected by surface operations and facilities are clearly marked. These signs and markers shall be maintained during all activities and retained and maintained until after the release of all bonds for the permit area.

C. Mine Operations

1. Introduction

1.1 Mine Property

The coal leases owned by Andalex Resources are located in the Deadman Canyon area of the Book Cliffs coal field. The property is located about 10 miles north-northeast of Price, Utah in Carbon County. Mining has begun in the Gilson seam on the Zion's fee lease and mining plans show development onto Andalex Resources

Federal leases in Lower Sunnyside as well. Mining plans also call for the development and operation of mines in the Aberdeen Seam. As is shown on the enclosed Plate 7, development into the other seams will involve separate surface facilities which will be located adjacent to the existing facilities in Deadman.

1.2 Economic Geology

This project is located in a region where coal mining has historically been the only industry. The main coal-bearing rocks occur in the Blackhawk Formation of the Upper Cretaceous Mesaverde Group. Several small operations have mined coal in the Deadman Canyon area over the past 70 years. These mines, however, merely scratched the surface of the estimated reserve. There are no other economically recoverable replenishable or non-replenishable resources within this property.

1.3 Exploration

All exploration and drilling programs have been completed. The drilling and exploration activities were supplemented by mine samples and outcrop information, and the results used to estimate the coal reserves of the lease area. Numerous samples were taken from the outcrops of the Lower Sunnyside, Gilson, and Aberdeen seams, as well as from mine faces in the Hileman, Zion's, Star Point, and Blue Flame No. 1 mines.

1.4 Reserves

By U.S. Geological Survey definition, approximately 30% of the entire reserve is classified as "measured". The remainder is classified as indicated, based on all available measurements.

Total coal reserves in the three seams have been estimated at 50 million tons. Recoverable coal has been estimated at 29 million tons. Andalex expects an initial recovery rate of about 35 percent and upon final pillar extraction, total recovery is expected to be more than 65 percent. Cover ranges from 0 feet to more than 2,400 feet on the northern end of the property.

1.5 Production Rate

Mining has begun in the Gilson seam and the production was approximately 200,000 tons of coal during the first year of operation. Production was systematically increased until an approximate rate of about 700,000 tons was reached during the fourth and fifth years.

1.6 Life of Mine

Including the Zion's fee area and Federal leases, there is an estimated 29 million tons of recoverable coal. If the extraction rate of one million tons per year is accomplished according to schedule, the project life will be about 28 years. Theoretically, however, the life is much greater, or approximately 40 years.

2. Underground Operation and Facilities

2.1 Mine Layout (Refer to Plates 29, 30 and 31).

2.1-1 Multiple Seam Considerations

There are three economic seams present on the property. The uppermost seam is the Lower Sunnyside which varies from four to six feet thick. The middle seam is the Gilson seam which varies from four to eight feet thick. The lowermost seam is the Aberdeen which varies from four to thirteen feet in thickness. These seams are generally separated by a 200 foot interval which includes a massive sandstone in each case. Mining plans are based on simultaneously operating a mine in each of these seams. The mine plans for each seam are shown on Plates 29, 30 and 31 . Mining began in the Gilson seam in October 1980 on the Zion's fee property. Mining plans call for advancement onto the Federal leases in the near future. Initial start-up of mining in the Lower Sunnyside and Aberdeen will be dependent upon the coal market and approval of this application. When mining is progressing concurrently in two seams, the upper seam mine plan will in effect be a "mirror image" of the lower seam. This will assure that maximum roof support is accomplished.

2.1-2 Portals

Portals for the present mining operations in the Gilson seam are located on the west side of Deadman Canyon as shown on Plate VI.. The portal area consists of a conveyor portal, two air intake portals, and an 88' fan portal.

Portals have been enlarged above the coal seam to facilitate men and equipment at the mine opening. Steel sets have been used to support mine roof in the portal area. All new portals will be constructed in a similar fashion, facilitating air intake, conveyor, and an exhaust fan.

The portals are generally 6' high and 20' wide.

2.1-3 Mains, Submains, Slopes

Initial mining has begun from portals on the west side of Deadman Canyon on the Zion's fee. A five entry system is being used (two intake portals) and using a continuous miner, the entries are being driven to the property line. Entries on 80 foot centers with crosscuts every 80 feet are being driven on the strike and dip of the coal seam. Refer to Plate VI. There exists only one return air portal on the surface, however, 2 exist underground making the five entry system.

2.1-4 Shafts and Interconnecting of Slopes

Mining plans call for no shafts or interconnections of slopes.

2.1-5 Mining Panels

The mining sequence calls for the development of panel entries. The panels formed will either be further developed for pillar extraction, or will be mined out using a longwall system.

2.1-6 Barrier Pillars

A barrier pillar will be left between the bleeders and the production panels. A barrier will also be left wherever old mine workings are skirted such as the Olsen Mine on the east side of Deadman Canyon in the Gilson seam.

2.1-7 Bleeder System

A bleeder system will be maintained and pillars left to provide for ventilation, eventually extending around all mined out areas.

2.2 Mine Safety

2.2-1 Ventilation

The ventilation plan calls for a fan of sufficient capacity to provide air to each working section to control methane and dust; there has been no methane found to date in any of the old works or new faces. The working faces will be ventilated with a live brattice system consisting of a line curtain. The conveyor systems will be isolated from intake and return. All ventilation requirements of the Coal Mine Health and Safety Act will be met. Plate XII shows a schematic representation of the plan which has been approved by M.S.H.A. This ventilation plan will be strictly adhered to, in order to insure safety of all personnel.

2.2-2 Roof Control

The Pinnacle Mine is operating under an approved M.S.H.A. roof support plan which calls for bolting on five foot centers with a minimum 42" bolt length. The roof in this mine, as well as in the other two seams is a massive sandstone (60'+) and offers excellent support in itself. The old mine workings which were rehabilitated for the Pinnacle Mine main entries had stood unsupported for the past 40 years. This roof control plan will be strictly adhered to, in order to insure the safety of all personnel.

2.2-3 Explosives

All blasting performed underground will conform to both state and Federal regulations governing explosives and blasting in underground coal mines. There may be a small amount of blasting conducted on the surface. This would consist of highwall preparation, if necessary, for purposes of stability.

A powder magazine has been set up on one of the surface pads, located in a remote area. It is a small concrete block structure conforming to all regulations, such as segregation, regarding such a structure (See Plate VI). All blasting operations shall be conducted by experienced, trained, and competent persons who understand the hazards involved and who possess a valid certificate as required by Title 30 of the Code of Federal Regulations.

2.2-4 General Safety Measures

A great emphasis will be put on assuring a safe mine operation; therefore, the mine and surface facilities will be operated within prudent standards to insure the health and safety of all employees. The facilities will be carefully inspected by company-trained safety engineers and State and Federal mine inspectors.

The operation will abide by Utah State Coal Mine Regulations and the 1969 Federal Coal Mine Health and Safety Act. In addition, these regulations will be supplemented by a company safety policy. Various training programs will be utilized such as the following:

Methane Measurements
Roof and Rib Control
Oxygen Deficiency Testing
Ventilation
First Aid
Mine Rescue
Mine Electrical Certification
Self Rescue Training
Use of Personal Protective Equipment
Recognition of Electrical Hazards
General Accident Prevention
Mine Communications
Job Safety Training

Many of the training programs will run continuously, such as those involving roof control and ventilation. Other programs are held annually with many oriented toward new employees.

2.3 Mine Development (Refer to Plates 29, 30 and 31).

2.3-1 Room and Pillar

Room and pillar design will be employed with development extraction estimated at 35 percent of the reserve.

2.3-2 Pillar Extraction

Once development is completed, pillar extraction will commence. Final pillar extraction will result in a total recovery rate of approximately 65 percent.

2.3-3 Longwall

This mining method will be looked at during the initial mine development and production. Should mining conditions in any of the seams prove adaptable to longwall mining, it is likely that one or more longwall units would be installed. Initial mining, as well as all development work, however, will be done by a continuous miner unit. A mining plan that can readily be converted to longwall mining will be followed.

2.3-4 Cycle and Sequence of Mining

Initial portals have been installed on the west side of the canyon. Mining began in October, 1980 utilizing one continuous miner section of equipment. As mining progresses, the following equipment will be added to start up additional mining areas and increase production:

2nd Mining Unit - February, 1981
3rd Mining Unit - September, 1981
4th Mining Unit - January, 1988
5th Mining Unit - September, 1988
6th Mining Unit - September, 1989

This, of course, is theoretical, depending on coal market conditions.

As there are three coal seams of mineable thickness on the leases, a systematic plan of mining will be followed to assure maximum recovery of the coal reserves. When mining is progressing concurrently in two seams, the upper seam will be mined in such a fashion that room and pillar design and layout will be a "mirror image" of the lower seams so pillars are on top of one another to assure maximum roof support.

2.4 Recovery and Conservation of Coal Resources

As there are three coal seams in mineable thickness on the leases, a systematic plan (as outlined in this chapter), employing the most advanced technology will be followed to assure maximum recovery of the coal reserves. An overall recovery rate during development of about 35 percent is anticipated. After pillar extraction, the total recovery rate will be approximately 65 percent. This recovery rate is the maximum possible using present technology. The topography of the area as well as amount of cover precludes any future surface mining activities.

2.5 Underground Equipment

2.5-1 Production Units

In each mine, the entry systems, as well as in the panel areas, coal will be mined with a drum-type continuous miner similar to the Joy 12CM. Presently, a Joy 12 CM-11 is being used in the operation on the Zion fee area. Coal will be transported by shuttle car (Joy) to a loading point consisting of a Long Airdox Feeder Breaker or similar machine, which will discharge onto a 36" panel conveyor or a 42" main conveyor. Roofbolting is and will be accomplished by a Lee Norse Top Dog Single Boom Roof Bolter or a similar type machine. Additional production units will be added as previously outlined in this Chapter, Part C, Section 2.3-4, re Cycle and Sequence of Mining.

2.5-2 Belt Conveyors

The coal will be discharged from the shuttle car into a feeder breaker. The feeder breaker will discharge the coal onto either a 36" panel conveyor or a 42" main conveyor. The conveyor will transport the coal to the outside, where it will be discharged to a live stockpile, (see Plate 6). Currently, a Long Airdox conveyor belt drive is being used. For future installations, the same, or similar drives will be employed.

2.5-3 Water System

Water for mining use, such as for providing face fire protection and dust suppression, will be obtained from Water Well No. 1, shown on Plate VIII. This water will be pumped to the Mine Water Storage Tank and from there into the mine using a high pressure pump. A sump will be cut in the mine for the purpose of reclaiming water as all available water will be needed. For this reason, no water will exit from the mine. Eventually, old worked out areas in the mine will provide a catch basin from which water can be reclaimed.

2.5-4 Power System

Incoming 46 KV, 3 phase, 60 hertz power supply from Utah Power and Light Company is stepped down by a substation to a distribution voltage of 4160 volts, 3 phase, 60 hertz for primary underground usage. The entire substation secondary and mine power distribution system has been designed, installed, and insulated in accordance with 8 KV specifications to facilitate the future conversion to a 7200 volt mine power distribution system. See Appendix I. Other surface power (office, bathhouse, etc.), is supplied from the substation with a 480 volt system.

2.5-5 Other Equipment

Other equipment being utilized or to be utilized includes mantrips, rock dusters, tractors, rubber tired scoops, electrics, power cables, pipe and signal equipment, communication equipment, and miscellaneous section tools. The mine is also equipped with emergency tools and necessary supplies in the unlikely event that a fire or explosion should occur, in accordance with M.S.H.A. regulations.

2.6 Return of Coal Processing Waste to Underground Workings

As raw coal is hauled from the permit area, there will be no processing waste and no return of waste to underground workings. If in the future it is decided that a processing facility is to be incorporated, waste or reject will be taken to an approved refuse disposal site, however, no "reject" will be taken back into the mine.

3. <u>Surface Equipment</u>

Surface equipment includes a Cat 980-B front end loader for loading 28 ton trailers and diesel tractors for coal haulage. Also, there will be a grader for road maintenance. Other equipment such as diesel scoops and tractors will be utilized on the surface from time to time for material haulage. However, these pieces of equipment are generally for underground use.

4. <u>Employment</u>

Andalex Resources is an Equal Employment Opportunity Employer.

The type of hourly employees to be hired include various skill levels ranging from the unskilled laborer to the highly skilled personnel, including miner operators, shuttle car operators, roof bolters, mechanics, and electricians. All hourly employees will be properly trained and certified where necessary in accordance with M.S.H.A. regulations. Currently, Andalex Resources' Pinnacle Mine employs 40 hourly wage earners. Naturally, as the mine expands, the personnel will expand proportionately at the rate of approximately 10 employees per unit shift. The Pinnacle Mine, as well as Andalexs future operations are located in Carbon County near the town of Price. Since this area is supported to a large degree by coal mining and other related industries, it is anticipated that a labor force will always be readily available.

Management and other salaried employees will consist of the Manager of Mines, the General Superintendent, the Mine Superintendents, the Mine Foreman, Safety Personnel, Secretarial and Clerical, Geologists, and Engineers. (See Table III-1).

5. Schedule of Development and Mining

As there are three economic seams present on the property, mining plans are based on simultaneously operating a mine in each seam. Initial mining began in October, 1980 in the Gilson seam, the middle seam, stratigraphically, on the Zion's fee property, using one continuous miner section of equipment. The production schedule projects an increase from 200,000 tons the first year to the full production rate of about 1,200,000 tons in the year.
The planned incremental increases are listed below:

Year	Production Rate Tons/Year
1st year	200,000
2nd year	600,000
3rd year	600,000
4th year	600,000
5th year	600,000

At this rate, the life of the mine would be more than thirty years. As the initial phases of mining progress, additional equipment will be added to increase production as described in this Chapter, Part C, Section 2.3-4 re Cycle and Sequence of Mining. However, it should be realized that final coal production is dependent upon the market for coal and the approval of the permit application. Plates 29, 30, and 31 show the mining plans. Subsequent years will be planned on the basis of the experience gained; however, the basic mining plan as outlined in this chapter will not be changed. Mining progression for the next 5 years is shown on Plates 29, 30 and 31, and will increase from 700,000 tpy current to 1.2 mm tpy by 1990 and will stay at this rate until mining is completed.

ORGANIZATION CHART

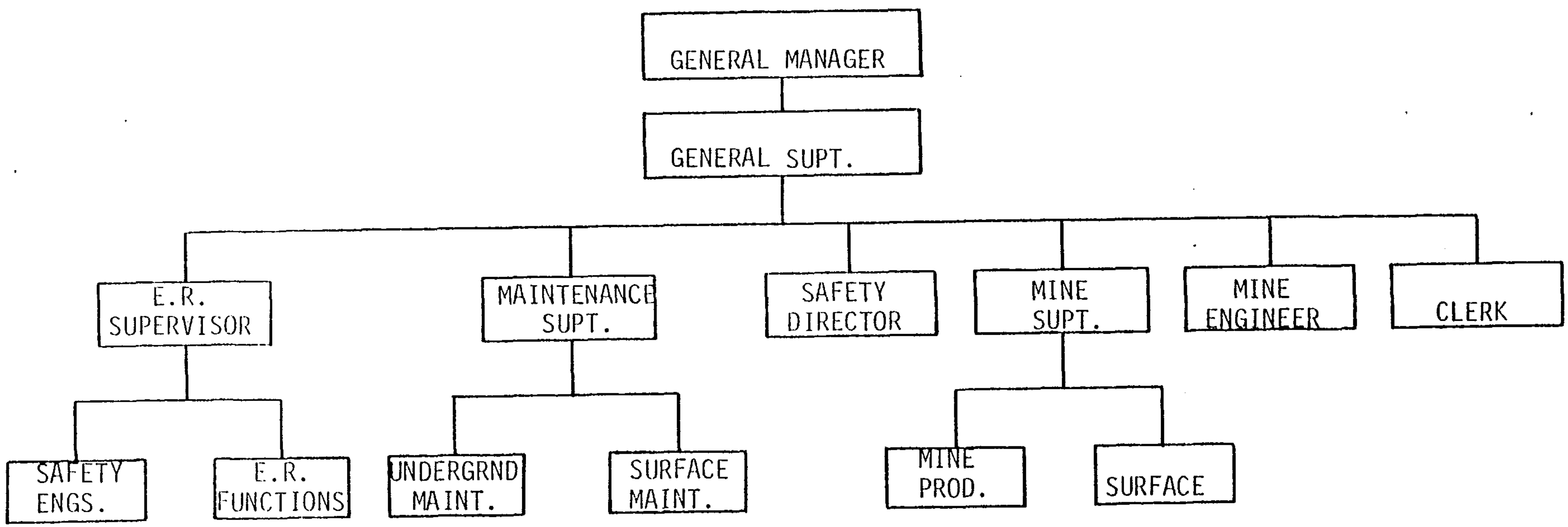


TABLE III-1

D. Environmental Protection

1. Protection of Hydrologic Balance and Compliance with Water Quality Laws

Andalex will follow its approved "Sedimentation and Drainage Control Plan" (See Appendix L.) and comply with the N.P.D.E.S. Permit No. UT-0023501 issued May 30, 1980 (See Appendix J.).

A gauging station will be maintained in the drainage to record future natural flows.

Andalex will comply with the Clean Water Act (33 U.S.C. Sec. 1251 et seq.) and all other applicable water quality laws and health and safety standards.

2. Subsidence Control Plan

2.1 Survey of Structures and Renewable Resource Lands

There are no structures present other than those constructed for mining operations, on the proposed permit area. The land is presently used for grazing and wildlife habitat and does not constitute a renewable resource area.

2.2 Mining Method

Mining will consist of the underground method of coal extraction using continuous miners, shuttle cars, and conveyor haulage. Room and pillar design will be employed with pillar extraction completing the operation. For more information on the mining method see Chapter III, Part C, Section 2.3, re Mine Development.

2.3 Geologic Factors

The Pinnacle Mine is located within the Blackhawk formation of the upper Cretaceous Meseverde Group. As is the case with all the active mines in the Book Cliffs coal field, the Pinnacle Mine drifts in from the outcrop and immediately the cover drastically increases as there are very steep sided cliff-like canyons. Naturally, the same factors are present in the Lower Sunnyside and the Aberdeen Seams. Therefore, from a geologic standpoint, the following conclusion can be drawn: it is assumed, as mining progresses, that as pillars are pulled, the roof will cave in behind the crews as they retreat. This is the normal scheme of mining in this type of development. In fact, if the cave does not occur as planned, serious mining problems can result. However, in a case such as ours, where the average cover over the coal seams is 1,000 feet or more, these caves will appear on the surface as minor cracks if at all. In other words, a solid block of overburden 1,000 feet thick will not drop into the 6 or 7 foot void resulting from pillar extraction. In fact, the rock will bridge off very quickly and result in minimal disturbance of the overlying country rock.

2.4 Preventive Measures

Stations will be set up as required for constant monitoring of subsidence movements. However, several facts should be pointed out. First and foremost, major subsidence is not expected to occur. Second, even if subsidence were to occur, no adverse impacts would result due to the current and future land use status. Third, due to the nature of this mine development, after pillar extraction, cave-ins are a necessity and therefore, preventive measures would serve only to decrease coal recovery and decrease the safety of the employees.

2.5 Mitigative Measures

As previously pointed out no major subsidence is expected to occur. However, if subsidence would occur there would be no material damage or diminution of valuable or foreseeable use of lands.

2.6 Monitoring

There are no structures or surface features which would be affected adversely by subsidence if it does occur. Monitoring stations, however, will be set up at the locations shown on Plate 32 as required under 30 CFR.

3. Fish and Wildlife Plan

Andalex will make every possible effort to minimize disturbances to wildlife habitat in the area and where possible enhance that habitat during reclamation. Refer to Chapter IV, Part E, re Fish and Wildlife Resources and Plan. It should be noted that there is no aquatic life in the permit area as these canyons are dry except as a result of direct precipitation (ephemeral streams). Andalex has performed numerous mitigative measures including extensive revegetation

4. Air Pollution Control Plan and Compliance with Air Quality Laws

4.1 Existing Environment

The permit area is located in a Class II air quality area.

4.2 Air Quality Impact Analysis

See the following section, section 4.3 re Emission Estimates.

4.3 Emission Estimates

Emission estimates are included as Appendix F in the form of an emission inventory. This inventory has been reviewed and approved by the Utah Bureau of Air Quality and the E.P.A.

4.4 Proposed Controls

Since this is an underground operation, no air quality problems are anticipated. The only changes in air quality will be attributable to minor road dust and exhaust mine dust. Methods of control are spray systems, chemical treatment, enclosures, and other fugitive dust control practices outlined in 30 CFR 817.95.

4.5 PSD Permit and Compliance with Air Quality Laws

The Environmental Protection Agency has determined that this project does not need a PSD air quality permit. This is based on our fugitive and non fugitive dust emissions inventory which assumes facilities necessary for 1 mm tons per year production. Further, the mine is not subject to the PSD regulations because of the new definition of a major source. (Refer to letter dated March 21, 1980 in Exhibit II-A). All applicable air quality laws will be complied with and fugitive dust control practices, as required under 30 CFR 817.95, will be followed.

5. Waste Disposal

5.1 Facilities

No waste disposal facilities will be needed for the existing operations. (Refer to Part B, section 10 of this chapter re Solid Waste Disposal and Handling Facilities). However, if at some point in the future Andalex decides that the preparation plant is to be added, all waste material will be disposed of in a designated, approved waste disposal site.

5.2 Special Measures (Refer to Part B, section 10 of this Chapter re Solid Waste Disposal and Handling Facilities).

5.2-1 Acid and Toxic-Forming Materials

No special measures are required due to the lack of acid and toxic-forming materials.

5.2-2 Combustible Materials

No special measures are required. All combustibles (paper, etc.), are collected in trash containers and hauled to local city and land fill areas.

5.2-3 Contingency Plans to Prevent Sustained Combustion

All which could burn would be small in quantity and consist of mine trash. The trash facility is segregated and if ignited accidentally, could be extinguished using either water or fire extinguishers.

6. Protection of Cultural and Historic Values

There are no public parks or historic places on the proposed permit area. Refer to Chapter IV, Part I, re Cultural and Historic Values.

7. Public Roads

There will be no underground mining activities within 100 feet of the right-of-way line of any public road, nor has any public road been relocated or are there any plans for such relocation.

8. Prime Farmlands

There are no lands identified as prime farmland within or adjacent to the proposed permit area. Refer to Chapter IV, Part E, re Soil Resources. See SCS letter following page 45. – see p140

9. Alluvial Valley Floors

No part of the proposed permit area or any adjacent area is located on an alluvial valley floor. Refer to Chapter IV, Part G, re Alluvial Valley Floors.

United States Department of Agriculture

Soil Conservation Service

P. O. Box 11350
Salt Lake City, UT 84147

February 17, 1987

RECEIVED
FEB 20 1987
ANDALEX RESOURCES, INC

Michael W. Glasson
Senior Geologist
Western Operations
Andalex Resources, Inc.
Tower Division
P.O. Box 902
Price, UT 84501

Dear Mr. Glasson:

In response to your letter January 28, 1987 addressed to Mr. George Cook, we have completed our review of the land area as requested (Sec. 5, 6, 7, 8, N 1/2 Sec. 17, N. 1/2 Sec. 18, T. 13 S., R. 11 E. Carbon County, Utah.

The soils in this site do not qualify in any category of Important Farmland because no irrigation water is available and slopes are steep.

We are retaining copies of the maps and documentation for future reference. If we can be of further assistance, please call on us.

Sincerely,

FERRIS P. ALLGOOD
State Soil Scientist

cc: Keith E. Beardall, District Conservationist, SCS, Price, UT

10. SLOPE STABILITY INVESTIGATION

TOWER RESOURCES, INC.
PINNACLE MINE

PRICE, UTAH

FEBRUARY 1981

ROLLINS, BROWN AND GUNNELL, INC.
PROFESSIONAL ENGINEERS

1435 WEST 820 NORTH, P.O. BOX 711, PROVO, UTAH 84601
TELEPHONE 374-5771

SLOPE STABILITY INVESTIGATION

TOWER RESOURCES, INC.
PINNACLE MINE

PRICE, UTAH

FEBRUARY 1981

ROLLINS, BROWN AND GUNNELL, INC.
Professional Engineers
1435 West 820 North, P.O. Box 711, Provo, Utah 84601

ROLLINS, BROWN AND GUNNELL, INC.
PROFESSIONAL ENGINEERS

February 13, 1981

Tower Resources, Inc.
P.O. Box 1027
Price, Utah 84501

ATTENTION: Mike Glasson

Gentlemen:

A slope stability investigation has been completed at the site of the Pinnacle Mine surface facilities north of Price, Utah. The investigation was performed to determine the factor of safety of an existing roadway located near the mine facilities. The work has been completed in accordance with a written proposal submitted to your organization for the work, and the results of the investigation are outlined in the following sections of this report.

The information contained in the report is discussed under the following headings: (1) geological and existing site conditions, (2) subsurface soil and water conditions, (3) the results of field and laboratory tests, (4) the results of a stability analysis performed for the roadway profile, and (5) summary and conclusions.

1. Geological and Existing Site Conditions

The Tower Resources, Inc. mine facilities are located on the northwestern flank of a large anticline which existed in tertiary time about fifty million years ago. The center of the anticline was located near the San Raphael Swell about sixty miles south of Price, Utah. The center of the anticline has been removed by erosion and a steep erosional escarpment characterizes the periphery of the anticline. Many steep-walled canyons have been eroded through the periphery of the anticline and the Tower Resources mining facilities are located in one of these canyons.

The principal geological formation in the area is the Blackhawk Formation, which is characterized by interbedded sandstones, mudstones, shales and coal. The general layout of the Pinnacle Mine surface facilities is presented in Figure No. 1 and the topography of the existing area prior to the construction of the surface facilities is presented in Figure No. 2.

1435 WEST 820 NORTH, P.O. BOX 711, PROVO, UTAH 84601 TELEPHONE 374-5771

The roadway where the stability analysis has been performed is located on fill formed from material blasted out of the mountainside. We understand that the fill material was permitted to reach equilibrium under the forces of gravity and no special provisions have been made for the densification or shaping of the existing fill.

A profile through the roadway, showing the approximate location of the original natural slope, the roadway cut, and the fill material is presented in Figure No. 3.

2. Subsurface Soil and Water Conditions

Based upon field observations, the most critical slope, insofar as stability is concerned, was selected along the line designated as AB. The characteristics of the subsurface material along this profile were defined by drilling one test hole to a depth of approximately 40 feet and excavating seven test pits along the slope of the fill material. The location of the drill hole and the test pits is presented in Figure No. 1.

The log for the test hole is presented in Figure No. 4, and it will be observed that the fill material extends to a depth of approximately 24 feet below the roadway surface. The natural material below the fill consists of a weathered shale layer, a fine coal seam, and sandstone. The fill material generally consists of silty, sandy gravel intermixed with coal refuse.

During the drilling of the test hole, sampling was performed at approximately 3-foot intervals throughout the upper portion of the soil profile and at 5-foot intervals thereafter. Continuous cores were obtained in the lower portion of the drill hole.

Samples were obtained by driving a 2-inch split spoon sampling tube through a distance of 18 inches, using a 140-pound weight dropped from a distance of 30 inches. The number of blows to drive the sampling spoon through each 6 inches of penetration is presented on the boring logs.

The sum of the last two blow counts, which represents the number of blows to drive the sampling spoon through 12 inches, is defined as the standard penetration value. The standard penetration value provides a reasonable indication of the in-place density of sandy material; however, some caution must be exercised in interpreting the results of penetration values in gravelly type soils, particularly where the size of the gravel particles is greater than the inside diameter of the spoon.

The results of the standard penetration tests performed at this location indicate that the fill material in the upper 15 feet of the soil profile is in a relatively loose condition. Below a depth of 15 feet, the fill material appears in a more dense state.

In-place density tests were performed in each of the test holes excavated along the slope, as shown in Figure No. 1. The results of these tests indicate that the in-place density of the fill material varies from 82 pounds per cubic foot to 110 pounds per cubic foot.

Each sample obtained during the drilling operations was classified in the laboratory according to the Unified Soil Classification System. The symbols designating the soil type according to this system are presented on the boring logs. A description of the Unified Soil Classification System is presented in Figure No. 5, and the meaning of the various symbols shown on the boring logs can be obtained from this figure.

Each sample obtained in the test pit was also classified according to the Unified Soil Classification System, and the symbols designating the soil type are presented in Table No. 1, Summary of Test Data.

No groundwater was encountered in the test boring drilled at this site, and it is not anticipated that any groundwater will be located within the fill material at this location.

3. The Results of Field and Laboratory Tests

The field and laboratory tests performed during this investigation to define the characteristics of the fill material include standard penetration tests, in-place unit weight, natural moisture content, mechanical analysis, and triaxial shear tests.

The standard penetration tests performed during the field investigations have been previously discussed, and the results of these tests are presented on the boring log.

As indicated earlier in this report, in-place density tests were performed in each of the test pits excavated along the slope of the fill. The results of these tests, along with the natural moisture content, are presented in Table No. 1, Summary of Test Data. The in-place density values varied from about 82 to 110 pounds per cubic foot, while the natural moisture content varied from about 8.6 to 13.9 percent.

The results of the mechanical analysis performed on each of the samples obtained from the test pits are presented in Table No. 1, Summary of Test Data, and it will be observed that the fill material appears to be relatively well-graded with an appreciable quantity of the material in the silt and clay size range.

The results of the mechanical analysis performed on samples obtained from the test hole are also shown in Table No. 1, and it will be observed that the gradation of this material compares favorably with the gradation of the material obtained from the test pits.

Moisture-density relationships were determined for material obtained from Test Pit Nos. 4 and 7, and the results of these tests are presented in Figure Nos. 5 and 6. The moisture-density relationships were determined in accordance with ASTM D 698-70, which is commonly known as the Standard Proctor. It will be observed that the maximum density varied from about 103.4, for the sample obtained from Test Pit No. 4, to 117.0 pounds per cubic foot, for the sample obtained from Test Pit No. 7.

The strength characteristics of the existing fill material were defined by performing three condolidated, drained, tri-axial shear tests on representative samples of the Minus No. 4 material obtained from Test Pit Nos. 2, 4 and 7. The results of these tests are presented in Figure Nos. 7 through 9. The moisture content and the density to which each sample was compacted is shown for each of the samples tested. It will be noted that the in-place density of the samples ranged from 88 to 99 pounds per cubic foot.

The friction angle for the three tests performed ranged from 30.5 degrees to 33 degrees, while the cohesion varied from 0, for the sample obtained from Test Pit No. 7, to 2300 pounds per square foot, for the sample obtained from Test Pit No. 2.

It is our opinion that these tests provide a reasonable indication of the strength characteristics of the subsurface material within the existing fill.

4. The Results of the Stability Analysis

A. Method of Analysis. The method of analysis used in the stability computations during this investigation followed a procedure outlined by Spencer. Spencer's method satisfies both force and moment equilibrium and is recognized as a satisfactory slope stability procedure. The computer program used in the analysis was developed by Stephen Wright of the University of Texas, and involves a search routine to determine the critical failure surface. The program is capable of performing either a total or an effective stress analysis.

B. Selection of the Shear Strength Parameters. The results of the subsurface investigation performed, both along the roadway and within the slope materials, indicate that no groundwater exists throughout the subsurface profile at this site. Furthermore, there is little indication that the fill material will ever be saturated throughout the life of the facility and that the material will exist in an unsaturated state with the approximate moisture contents as those determined during this investigation. For this reason, it is our opinion that shear strength parameters characteristic of the in-place material should be used in a stability analysis for the fill at this location.

Based upon the results of the triaxial shear tests, a friction angle of 32 degrees and a cohesion not exceeding 250 pounds per square foot have been assumed in this analysis. It is our opinion that a cohesion value of this magnitude is a reasonable assumption, since two of the triaxial shear tests performed indicated cohesive strengths considerably greater than the value indicated above.

Since the subsurface materials throughout the site contain an appreciable quantity of material in the silt and clay size range, and since the material is unsaturated, it would be expected that the fill material would possess some cohesion due to capillary effects. In performing the stability analysis, an in-place unit weight equal to 102 pcf was assumed for the fill material.

C. The Results of the Analysis. The stability analysis was performed assuming a profile through the roadway as shown in Figure No. 3. The line designating the original natural slope was based upon observations along the roadway, along with the depth at which bedrock was encountered in the drill hole. Since the strength of the bedrock is substantially greater than the strength of the fill material, it was assumed in the stability analysis that the failure surface would not extend below the original ground surface line.

Factors of safety were obtained for a friction angle of 32 degrees and cohesion values, varying from 100 to 250 pounds per square foot. The factors of safety associated with the various combinations of friction angle and cohesion are presented in Table No. 2 shown on the following page. The critical failure surfaces for each of the factors of safety shown in the table are presented in Figure No. 3.

Table No. 2

Factors of Safety for
Various Shearing Strength Parameters

Friction Angle	Cohesion	Factor of Safety
32	100	1.31
32	150	1.44
32	200	1.56
32	250	1.68

It will be observed that a factor of safety of greater than 1.5 is obtained for a friction angle of 32 degrees and a cohesion value of 200 pounds per square foot. It is our opinion that a cohesion value of 200 pounds per square foot is a conservative estimate of the existing cohesion within the fill material, and that the existing slope has a factor of safety of at least 1.5.

5. Summary and Conclusions

A stability investigation has been performed for a roadway fill in the vicinity of the Pinnacle Mine facilities north of Price, Utah. The roadway fill was formed, in part, from material blasted out of the mountainside. The fill material was permitted to reach equilibrium under the force of gravity and no special provisions were made to densify the fill material.

The characteristics of the subsurface material within the fill were defined by drilling one test hole and excavating seven test pits along the slope of the fill. The results of the field investigations indicate that the fill material is in a relatively low-density state.

The shear strength parameters were determined for the fill material by performing three consolidated, drained, triaxial shear tests on representative samples of the subsurface material. The specimens used in the triaxial shear tests were densified to unit weights approximating those in the fill material. The results of the triaxial shear tests indicated that a friction angle of 32 degrees and a cohesion of at least 250 pounds per square foot could be used to characterize the strength of the fill material.

The results of a computer stability analysis indicate that the slope defined by Figure No. 3 has a factor of safety of at least 1.5 against a slope stability failure.

If there are any questions relative to the information contained herein, please advise us.

Yours truly,

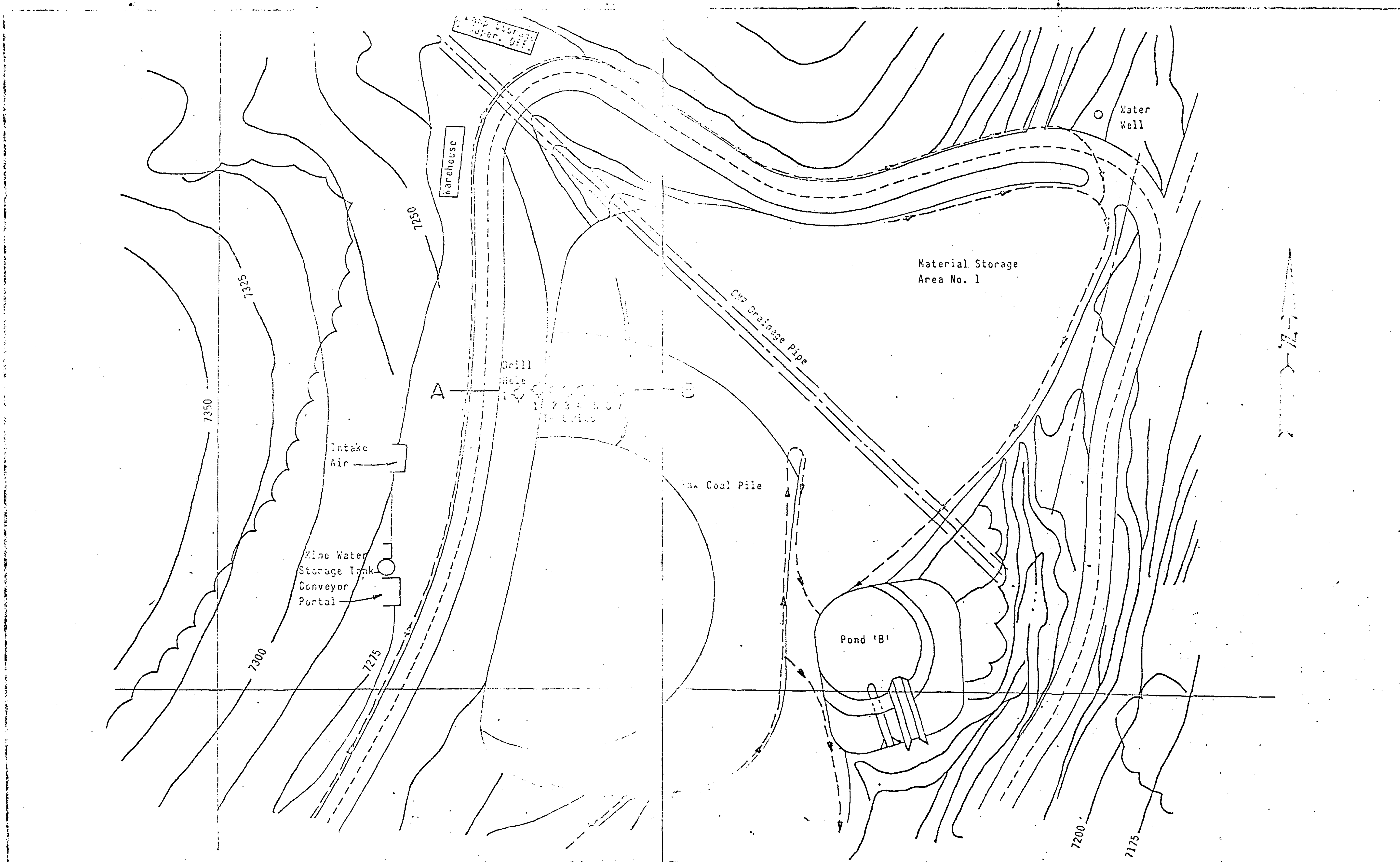
ROLLINS, BROWN AND GUNNELL, INC.

Ralph L. Rollins

Ralph L. Rollins

kf

Enclosures



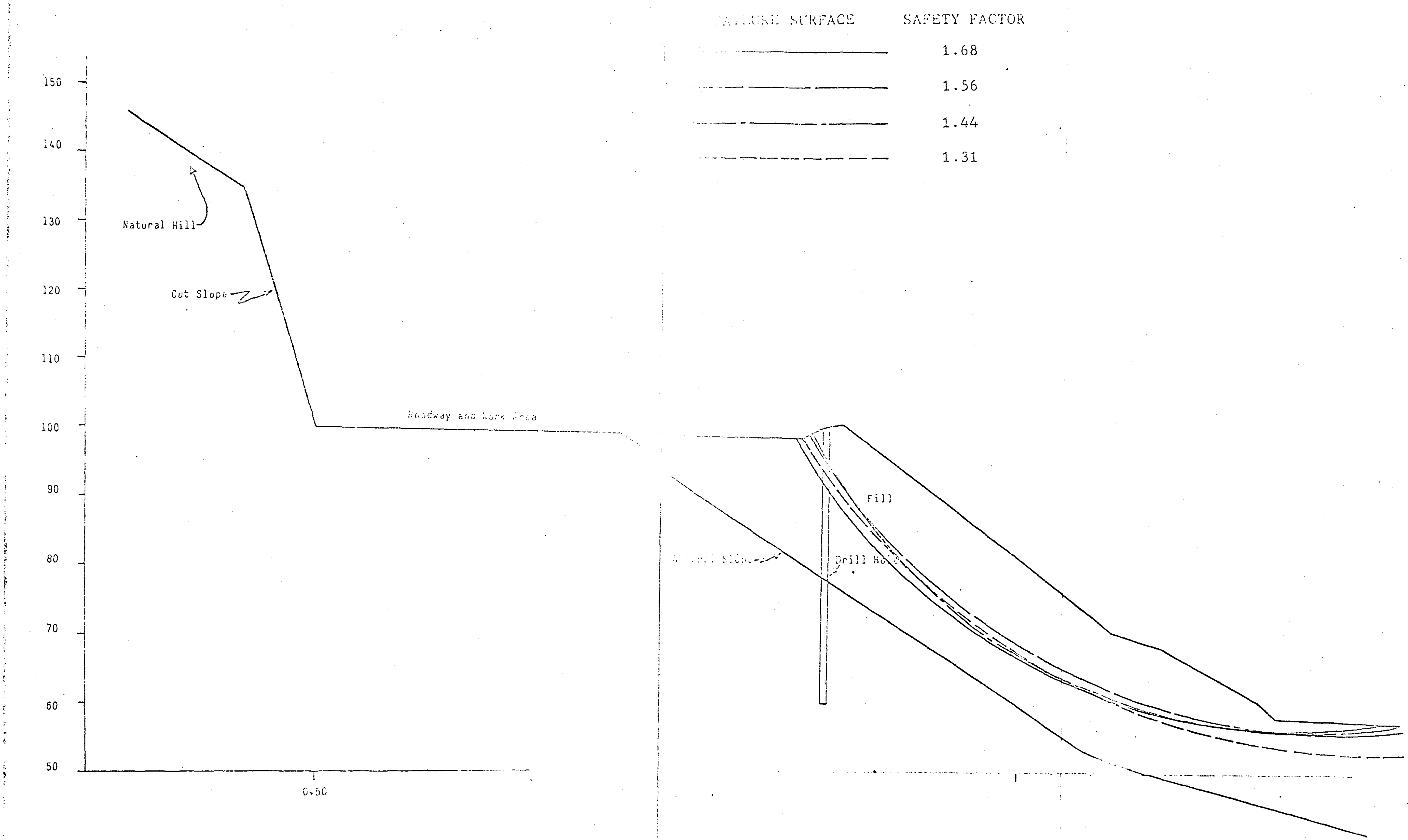
SCALE
DESIGNED ____ CHECKED ____
DRAWN ____ DATE ____
APPROVED ____ LICENSE NO. ____

CONSULTING ENGINEERS

RESOURCES, INC. PINNACLE MINE SURFACE FACILITIES

Figure No. 1

SCALE	ROLLINS, BROWN & GUNNELL, Inc.	NATURAL CONTOUR	Figure No. 2
DESIGNED / CHECKED	CONSULTING ENGINEERS	TOWER RESOURCES, INC. PINNACLE MINE	
DRAWN / DATE			
APPROVED / LICENSE NO.			



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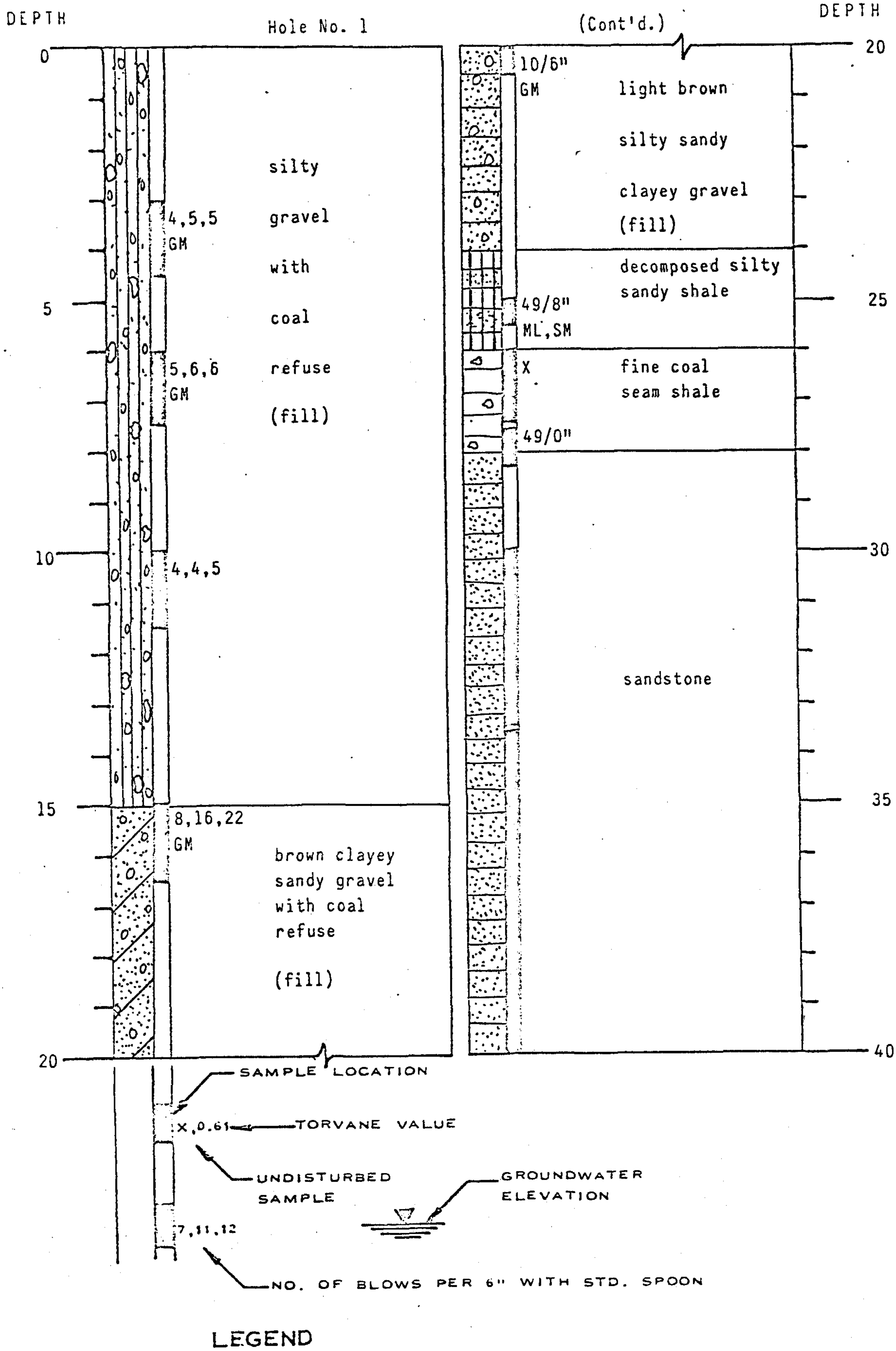
APPROVED ___ LICENSE NO. ___

CONSULTING ENGINEERS

RCES, INC. PINNACLE MINE

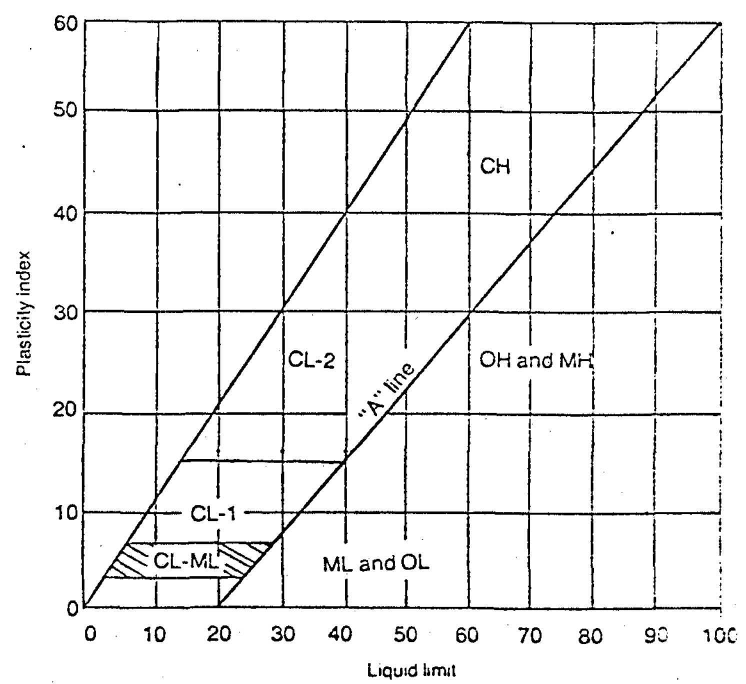
Figure No. 3



Log of Borings for: Tower Resources, Inc.	ROLLINS, BROWN AND GUNNELL, INC. Consulting Engineers	Figure No. 4

Unified Soil Classification System

Major divisions			Group symbols		Typical names	Laboratory classification criteria		
Coarse-grained soils (More than half of material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravels (Little or no fines)	GW		Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: Less than 5 percent .... GW, GP, SW, SP; More than 12 percent .... GM, GC, SM, SC; 5 to 12 percent .... Borderline cases requiring dual symbols**	$Cu = \frac{D_{60}}{D_{10}}$ greater than 4, $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and	
			GP		Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW	
		Gravels with fines (Appreciable amount of fines)	GM*	d / u	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
			GC		Clayey gravels, gravel-sand-clay mixtures		Atterberg limits above "A" line with P.I. greater than 7	
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW		Well-graded sands, gravelly sands, little or no fines		$Cu = \frac{D_{60}}{D_{10}}$ greater than 6, $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and	
			SP		Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM*	d / u	Silty sands, sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Limits plotting in hatched zone with P.I. between 4 and 7 are borderline cases requiring use of dual sysbols
			SC		Clayey sands, sand-clay mixtures		Atterberg limits above "A" line with P.I. less than 7	
Fine-grained soils (More than half of material is smaller than No. 200 sieve)	Silts and clays (Liquid limit less than 50)		ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity			
			CL	1 / 2	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
			OL		Organic silts and organic silty clays of low plasticity			
	Silts and clays (Liquid limit greater than 50)		MH		Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts			
			CH		Inorganic clays of high plasticity, fat clays			
			OH		Organic clays of medium to high plasticity, organic silts			
Highly organic soils			Pt		Peat and other highly organic soils			



Plasticity Chart

*Division of GM and SM groups into subdivisions of d and u for roads and airfields only. Subdivision is based on Atterberg limits, suffix d used when L. L. is 28 or less and the P.I. is 6 or less, the suffix u used when L. L. is greater than 28.

** Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example GW-GC, well-graded gravel-sand mixture with clay binder.

FIGURE 6 SOIL MOISTURE DENSITY RELATIONSHIP
ASTM D 698-70
MAXIMUM DENSITY 103.4 LBS. PER CU.FT.
OPTIMUM MOISTURE 13.5 %
PROJECT: Tower Resources, Inc.
LOCATION: Pinnacle Mine, Test Pit No. 4

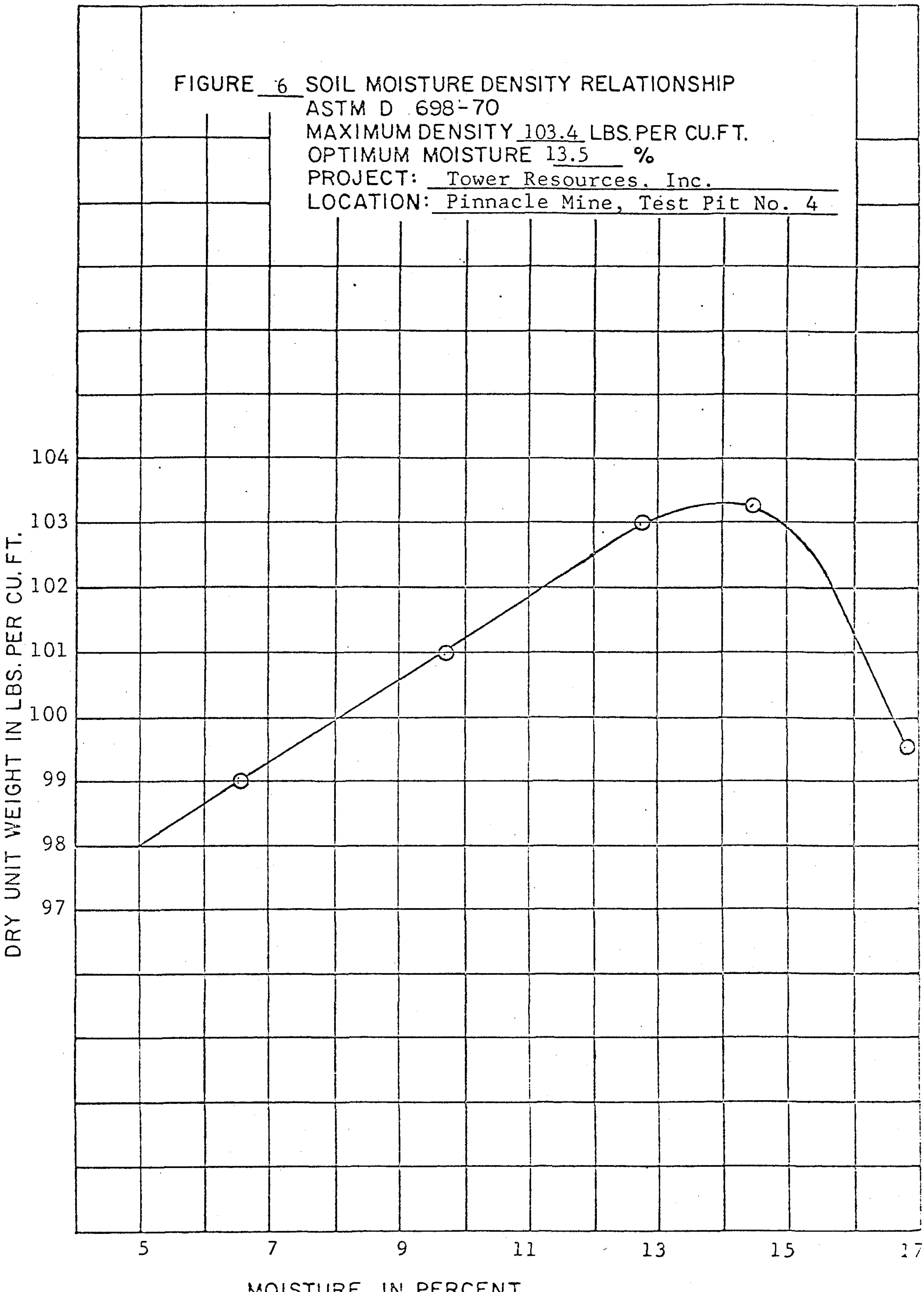
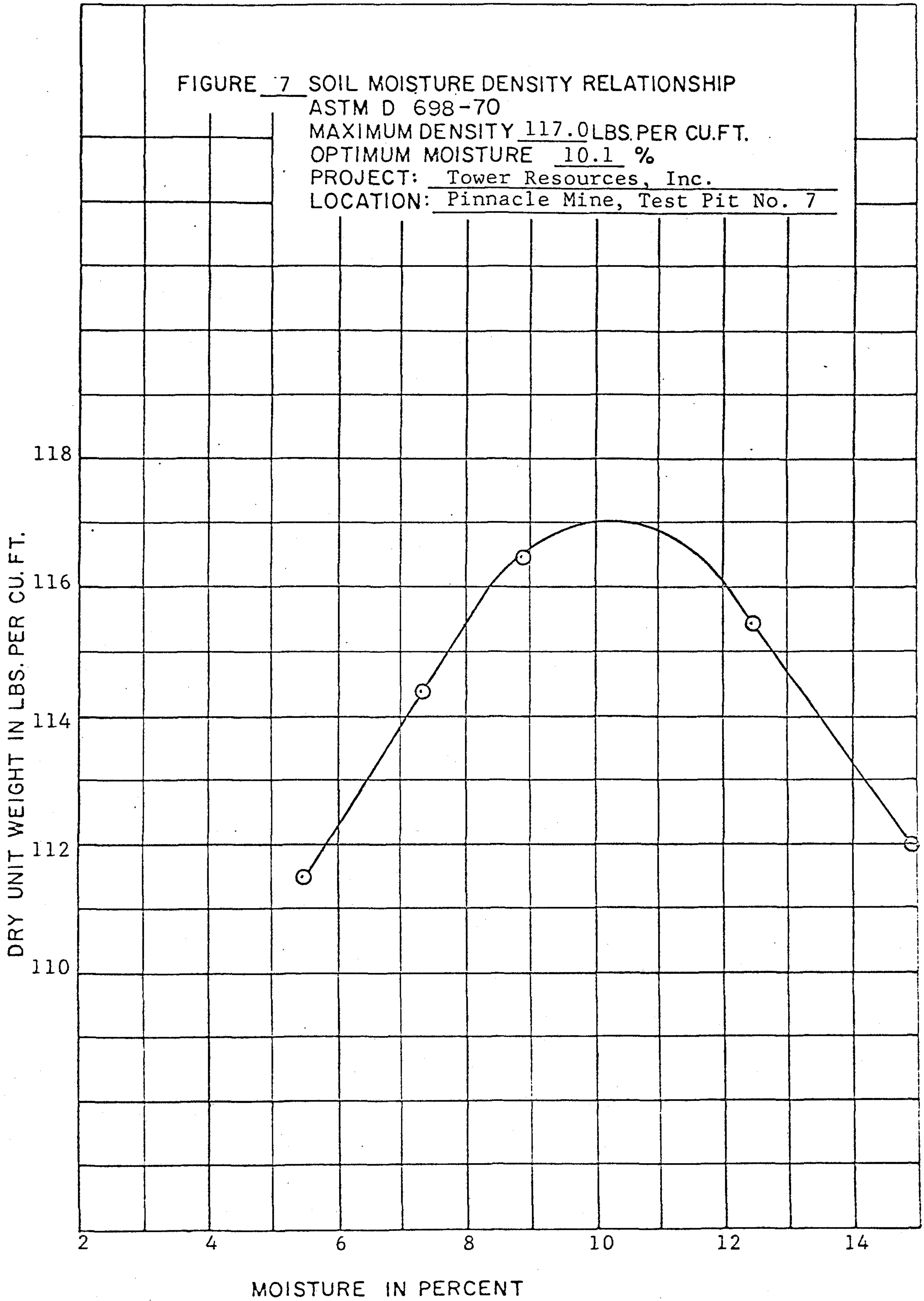
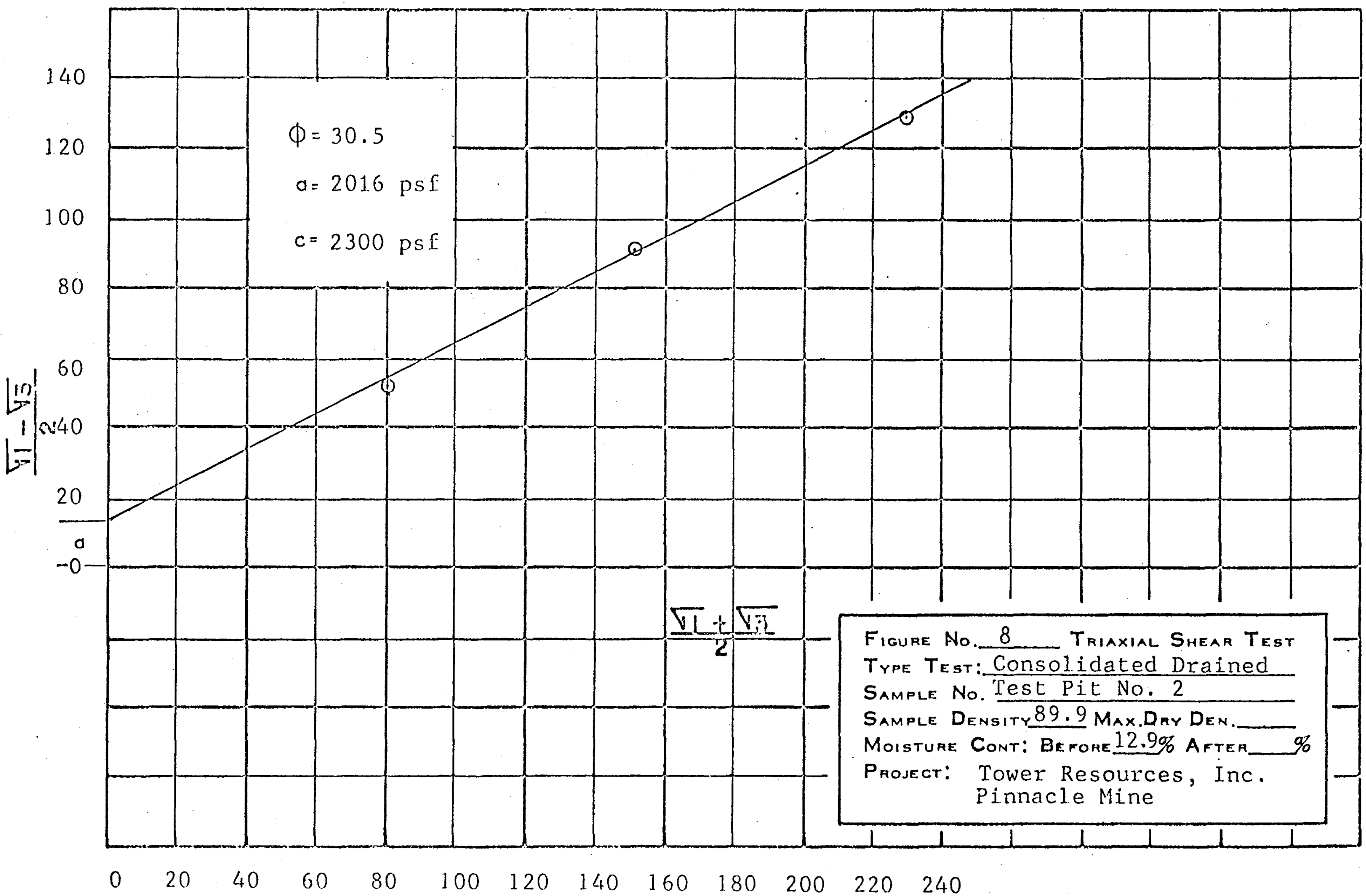


FIGURE 7 SOIL MOISTURE DENSITY RELATIONSHIP
ASTM D 698-70
MAXIMUM DENSITY 117.0 LBS. PER CU.FT.
OPTIMUM MOISTURE 10.1 %
PROJECT: Tower Resources, Inc.
LOCATION: Pinnacle Mine, Test Pit No. 7





ϕ = 30.5
a = 2016 psf
c = 2300 psf
$\frac{\sqrt{1}-\sqrt{3}}{2}$
140
120
100
80
60
40
20
a
0
$\frac{\sqrt{1}+\sqrt{3}}{2}$
0 20 40 60 80 100 120 140 160 180 200 220 240
FIGURE No. 8 TRIAXIAL SHEAR TEST
TYPE TEST: Consolidated Drained
SAMPLE No. Test Pit No. 2
SAMPLE DENSITY 89.9 MAX. DRY DEN. ____
MOISTURE CONT: BEFORE 12.9% AFTER ____%
PROJECT: Tower Resources, Inc.
Pinnacle Mine

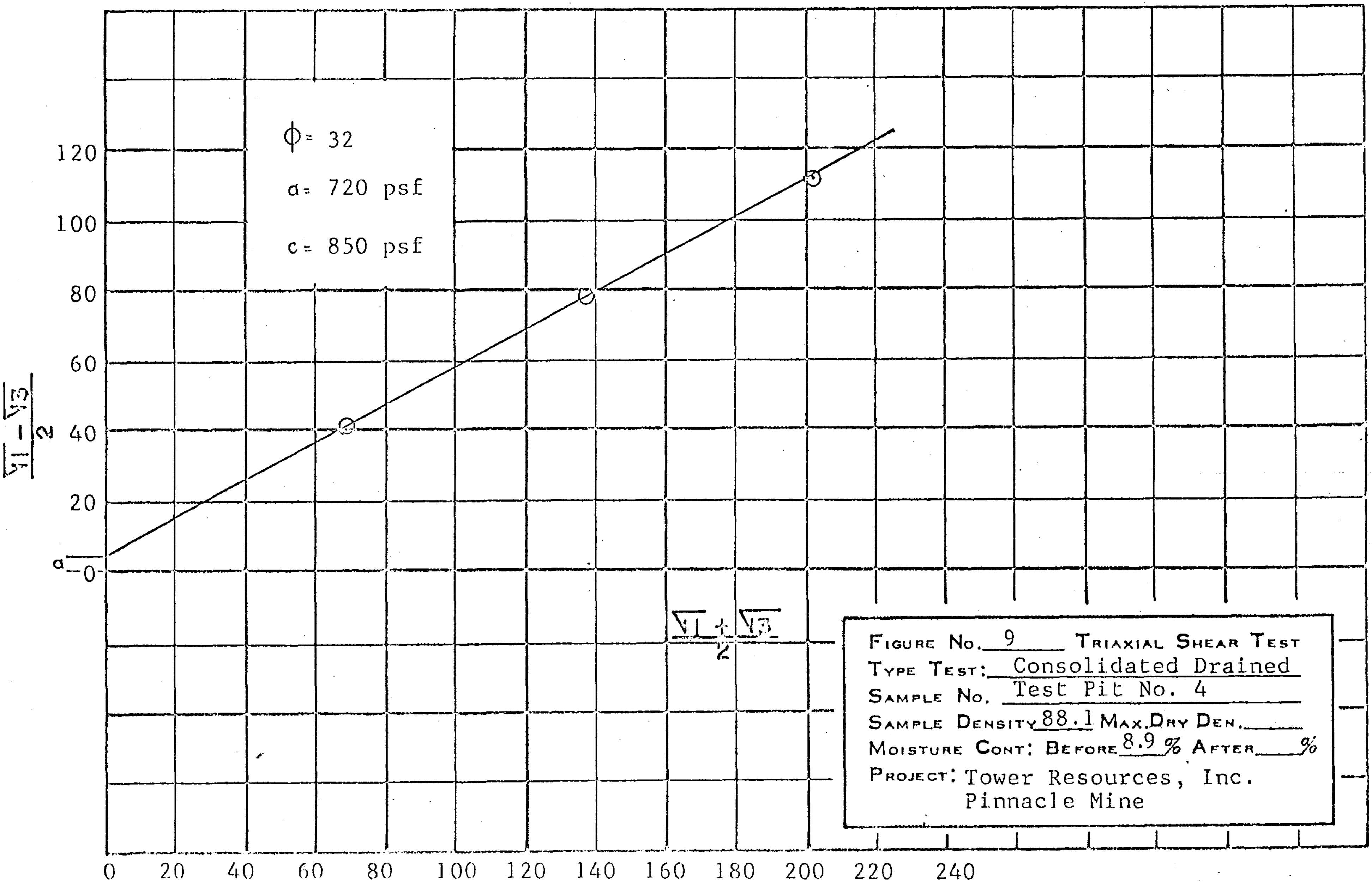


FIGURE NO. 9 TRIAXIAL SHEAR TEST
TYPE TEST: Consolidated Drained
SAMPLE NO. Test Pit No. 4
SAMPLE DENSITY 88.1 MAX. DRY DEN. ____
MOISTURE CONT: BEFORE 8.9 % AFTER ____ %
PROJECT: Tower Resources, Inc.
Pinnacle Mine

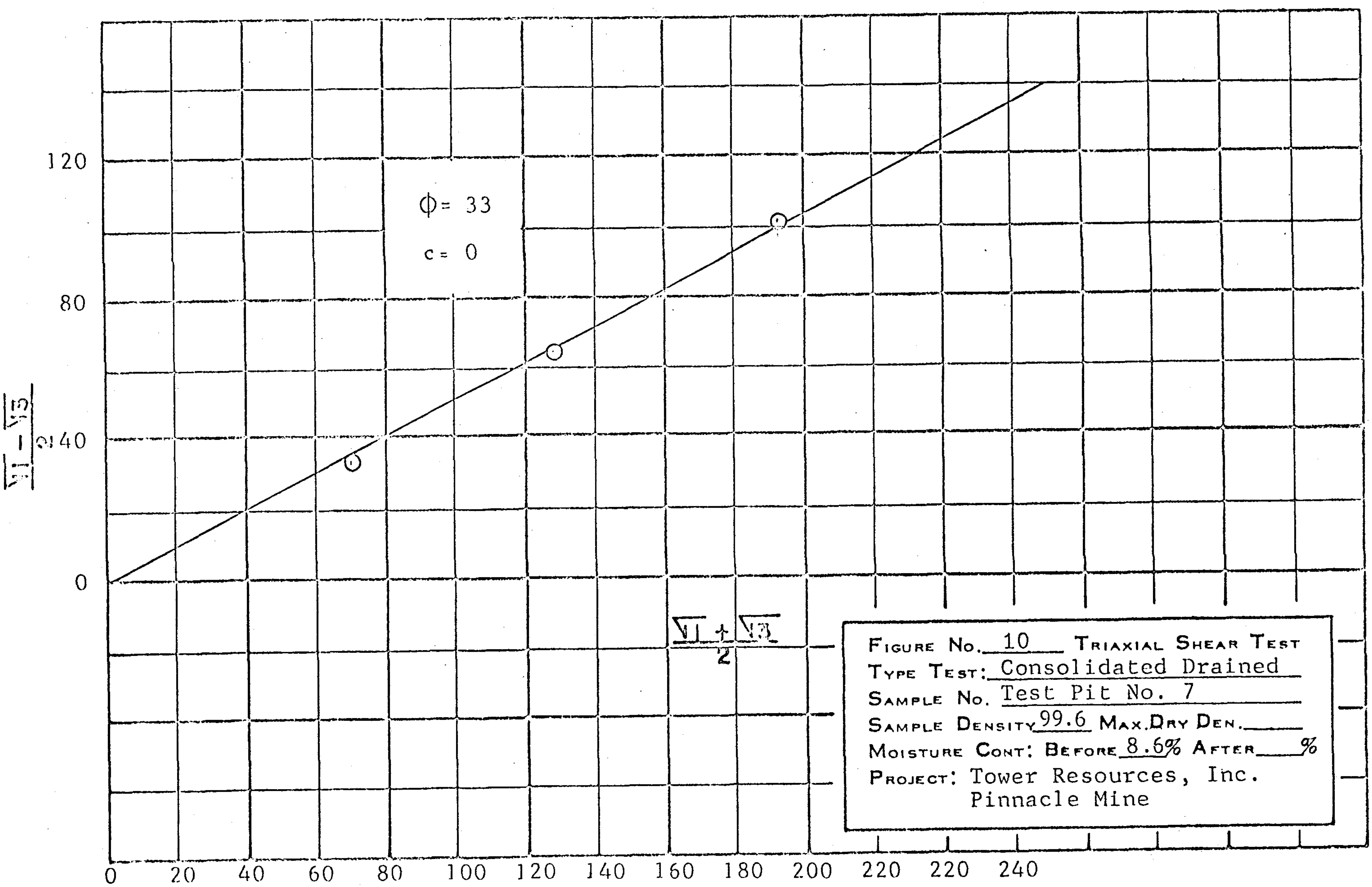


FIGURE NO. 10 TRIAXIAL SHEAR TEST
TYPE TEST: Consolidated Drained
SAMPLE NO. Test Pit No. 7
SAMPLE DENSITY 99.6 MAX.DRY DEN.
MOISTURE CONT: BEFORE 8.6% AFTER ___%
PROJECT: Tower Resources, Inc.
Pinnacle Mine

TABLE NO. 1 SUMMARY OF TEST DATA

PROJECT Tower Resources Inc. Pinnacle Mine FEATURE Foundations LOCATION Price, Utah

HOLE NO.	DEPTH BELOW GROUND SURFACE	STANDARD PENETRATION BLOWS PER FOOT	IN-PLACE UNIT WEIGHT LB/FT^3	IN-PLACE MOISTURE PERCENT	IN-PLACE VOID RATIO	UNCONFINED COMPRESSIVE STRENGTH LB/FT^2	FRICTION ANGLE ϕ	CONSISTENCY LIMITS L.L. %	CONSISTENCY LIMITS P.L. %	CONSISTENCY LIMITS P.I. %	MECHANICAL ANALYSIS % GRAVEL	MECHANICAL ANALYSIS % SAND	MECHANICAL ANALYSIS % SILT & CLAY	UNIFIED SOIL CLASSIFICATION SYSTEM
1*	6' down		101.2	11.5							31.4	37.5	31.1	GM
2	12' down		101.9	12.9							42.8	26.5	30.7	GM
3 *	18' down		81.6	8.6							46.5	31.8	21.7	GM
4	22' down		85.0	8.9							45.2	34.4	20.4	GM
5*	27' down		104.7	10.8							29.1	40.9	30.0	GM
6	29' down		109.7	13.9							57.1	26.7	16.2	GM
7*	35' down		81.7	8.6							20.9	56.4	22.7	GM
1	3-4.5*	10									32.7	30.1	37.2	GM
	6-7.5*	12									47.2	31.1	21.7	GM
	10-11.5*	9									54.0	31.1	14.1	GM
	15-16.5*	36									24.1	43.2	32.7	SM
	20-20.5	10/6									17.4	43.1	39.5	SM
	25-25.5	49/6						NON-PLASTIC			16.3	34.8	48.9	ML,SM
	[illegible]-27.5*	SHELBY						NON-PLASTIC			0.0	27.8	72.2	COAL

E. Reclamation

1. Post Mining Land Use

Upon completion of Andalex Resources' mining operation the land will continue to be used for grazing and hunting. The limited resources, both physical and scenic, will dictate no future change in the land status. The nature of an underground mine of this size requires minimal surface disturbance. All disturbed areas shall be restored in a timely manner to conditions that are capable of supporting the uses which they were capable of supporting before any mining.

2. Timetable of Major Reclamation Steps

As this is an underground mine there will be a limited amount of surface disturbance, consequently, reclamation will be uncomplicated.

All disturbed areas no longer required for the conduct of mining operations were immediately revegetated. In the future, any areas no longer required for operations will also be immediately reclaimed and revegetated.

When buildings and final site preparation had been completed, the soil was revegetated to prevent erosion.

When the project is expired, all buildings and extraneous material will be removed, all mine openings will be covered and sealed, roads will be regraded and using the most advanced technology at the time, Andalex will re-establish the terrain to as nearly the original as practical. The area will be reseeded and vegetation re-established in accordance with recommendations from the regulatory authorities.

3. Major Reclamation Steps

3.1 Removal of Surface Structures

Upon completion of mining activities, all surface facilities will be removed. The coal pile area, will be filled, the slope contoured, compacted, topsoil replaced, regraded, and revegetated. In the materials storage and building areas, all structures and foundations including the office building, bathhouse, substation, and water storage tanks, will be removed, recontoured, compacted, topsoil replaced and graded, and revegetated according to revegetation procedures described in Chapter IV, Part D, section 5 re Revegetation Plan.

3.2 Abandonment of Portals and Underground Workings

Upon completion of mining activities, the portals will be sealed according to existing state and Federal regulations. Conveyors will be removed and pads filled. The slope will be contoured, compacted, and topsoil replaced and graded. Revegetation will be carried out according to the revegetation plan outlined in Chapter IV, Part D section 5 re Revegetation Plan. See detail following page 47.

3.3 Casing and Sealing of Drill Holes

All exploratory drill holes have been sealed with cement and all water wells have been cased with steel casing and will be maintained. After mining is completed, the water wells and monitoring wells will be sealed.

3.4 Backfilling, Grading, and Soil Replacement and Stabilization

All disturbed areas will be backfilled and graded to as near as possible the approximate original contour, and to the most moderate slope possible. Slopes shall not exceed the angle of repose or such lessor slopes as required by the regulatory authority to maintain stability. Fill material will be compacted to assure stability.

Areas to be regraded include the portal site surface facility site and roads. Because of the diversity of these areas all regrading will conform to the specific site.

Where possible all final grading and placement of topsoil will be done along the contour to minimize erosion. In all cases, grading will be conducted in a manner which minimizes erosion and provides a stable surface for the placement of topsoils.

Upon reclamation, topsoil will be hauled to the area by end dump trucks, piled and spread using a grader. Where possible the soil will be distributed along the contour. The thickness of the re-established soil will be consistent with soils in the vicinity and will be sufficient to support vegetation equal to or superior to pre-mining history. All topsoil will be replaced according to UDOGM guidelines.

3.5 Revegetation

Revegetation will be accomplished by Andalex or under Andalex's direct supervision and under the recommendations of the regulatory authority as outlined in Chapter IV, Part D, section 5, re Revegetation Plan. Included is the mixture for drainage and steep slopes. Also Plates 19 and 20.

Comment UMC 784.14 Reclamation Plan:
Protection of Hydrologic Balance-JRH

Response:

The final sealing of mine openings will be accomplished by placing a recessed concrete block seal 25 to 50 feet from the mouth of the portal. Since a portion of the mine slopes towards the portals, and mine water is present, seals will be constructed with at least one drainage pipe in the lowest portal. This pipe shall be a schedule 80 - 4" PVC, with a U-tube water trap and a valve or cap on the end. The pipe will be extended beyond the portal backfill to allow for sampling. The area from the seals to the mouth of the portals will be backfilled. The portal structures will be removed and the exposed coal seam, including portal area, will be covered during reclamation.

If a discharge is found to occur after sealing, the water will be sampled quarterly for compliance with effluent standards of 817.42 and treated (if necessary) during the liability period. See Figures III-1 and III-2 for portal sealing details.

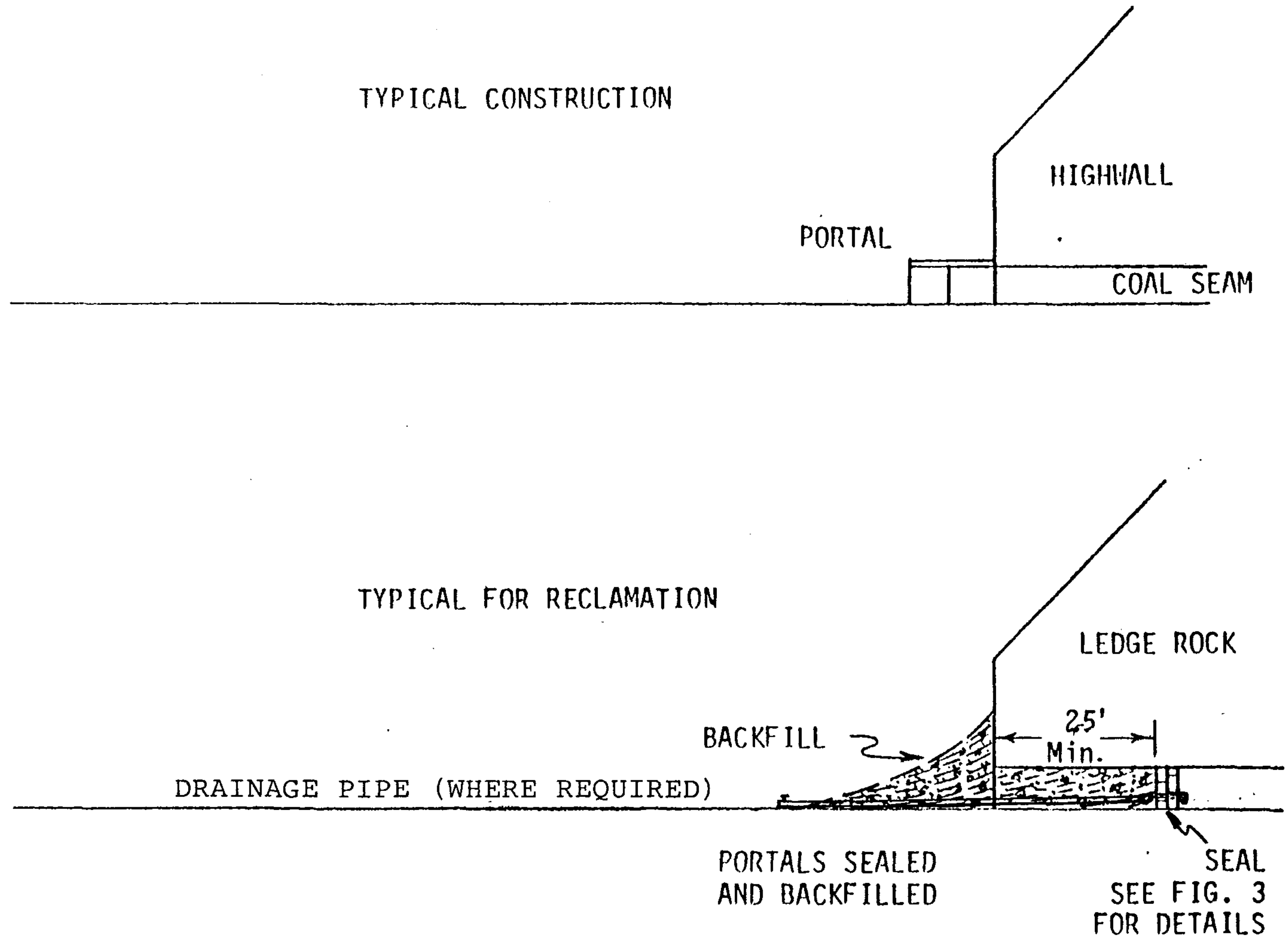
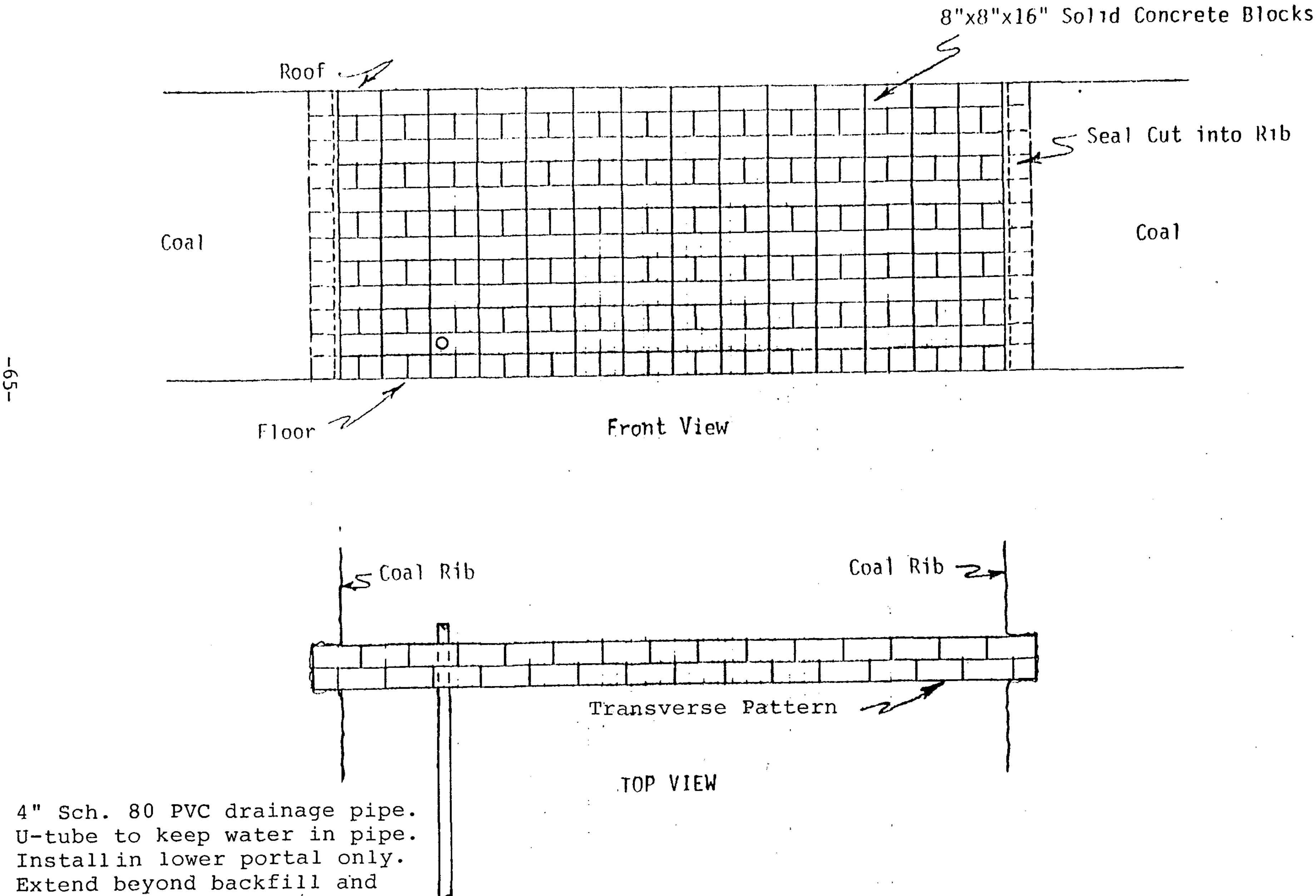


FIGURE III-1
TYPICAL PORTAL SEALING

FIGURE [illegible]-2

TYPICAL PORTAL SEAL

Scale 1"=4'



4. Reclamation Cost and Bonding

4.1 Cost of Reclamation

4.1-1 Detailed Estimate

A detailed cost projection is included as Appendix K.

4.1-2 Calculations

Calculations of the estimate are included in Appendix K.

4.2 Bond or Surety Arrangement

Andalex currently holds a bond, approved by UDOGM in the amount of $381,000.00 dollars and it is included in this MRP in Chapter II.

ABERDEEN MINE
SURFACE AND SUPPORT FACILITIES
(Refer to Plates 6 and 7)

Introduction

Construction is scheduled to begin on the Aberdeen Mine surface and support facilities during the second quarter of 1989. The projected schedule will be dependent on the coal market.

All proposed surface and support facilities are shown on Plate 7 and will consist of the following:

Coal Pile Storage Area	1.5 acres
Coal Pile (Live)	10,000 tons
Fan and Portal Area	.5 acres
Portals	5' x 20' (4 ea.)
Mine Fan	72"
Mine Water Storage Tank	12' x 16'
Topsoil Storage Area	.05 acres
Sedimentation Pond	.20 acres

This proposed minesite has been previously impacted by mining activity.

Construction

Once topsoil has been removed, sites for these surface and support facilities will be leveled using dozers, trucks, and front end loaders. Surface pads will be gravelled and all other areas (ponds, embankments, etc.) will be reseeded according to recommendations of the appropriate regulatory authorities. Any blasting necessary for highwall preparation will be conducted in accordance with 30 CFR 817.61-68. All construction activities will be conducted as outlined in Chapter III, Volume I, of this Mining and Reclamation Plan.

Topsoil

Topsoil will be removed as a separate operation from areas to be disturbed by surface installation. It will be removed from the sites and transported to the designed topsoil storage area. It will be segregated, stockpiled and protected from wind and water erosion and contaminants through revegetation. This storage area will be clearly marked with appropriate signs.

Transportation Corridors

Access to the portal area will be via the existing road to the office site.

Durings its life this road will be constantly maintained. All necessary repairs will be made in a timely manner. The road will be chemically treated with a magnesium chloride solution to control dust. In winter months, snow will be removed, the road graded and kept open. Signs will be posted at strategic points along the road to warn of any possible hazards which might exist.

Portals

Portals and exhaust fan will be located as shown on Plate 6. This pad will contain a conveyor portal, two intake portals, the exhaust fan portal and 72 inch exhaust fan. These portals will be enlarged above the coal seam to facilitate men and equipment at the mine openings and will be generally 5 feet high and twenty feet wide. Steel sets will be used to support the roof in the portal area. There will be only four portals opening on the surface; however, an additional return air portal will be driven underground making it a five entry system.

Coal Handling and Storage

As mining begins, coal will be discharged from a shuttle car onto a 36" panel or a 42" main conveyor belt for transportation to the outside. Once outside the coal will be discharged onto a live coal stockpile (approximately 10,000 tons). The pa d containing this stockpile will cover approximately 1.5 acres and will include an area for truck loading and turn-around. Coal will be loaded from this stockpile by front end loader onto 40 ton trucks and hauled to various loadouts as described in Chapter III, Volume I, of this Mining and Reclamation Plan.

Water System

Water for mining use such as for providing face fire protection and dust suppression, will be stored in the Mine Water Tank as shown on Plate 6 . The water will be pumped into the mine using a high pressure pump. A sump will be cut in the mine for the purpose of reclaiming and storing water as all available water will be needed.

Power System

Power supply will be from the existing substation located at the Pinnacle Mine.

Sediment Control

The proposed minesite will have a total disturbed area of approximately 33 acres. The major drainages in the proposed minesite area will be allowed to by-pass the site via culverted channels. In order to minimize additional sediment loading into the main drainage, the run-off from disturbed areas will be collected and passed into a sedimentation pond. Most of the run-off from undisturbed areas in the proposed minesite vicinity will be unaltered and allowed to pass through existing natural channels. Berms will be placed on the lower edge of all disturbed areas to prevent run-off from reaching natural drainages before passing through the sedimentation pond.

The proposed ponds will be located as shown on Plate 7. This pond has been designed to fully contain the expected run-off and a sediment load from a 50 year - 24 hour precipitation event in the area of drainage. These sedimentation ponds have been designed according to O.S.M. regulations and will be constructed similarly to the "Sedimentation and Drainage Control Plan" certified by a State Registered Professional Engineer. This Plan is included as Appendix L in Volume I of this Mining and Reclamation Plan.

The proposed site for this pond has been chosen for effective control of sediment and for minimization of environmental destruction.

The pond will be inspected after each storm and will be cleaned at a minimum when sediment reaches 60% of volume. Water monitoring stations will be established at the outlet of the pond and will be sampled according to frequencies specified in the NPDES permit.

Mine Operations

All mining activity in the proposed Aberdeen Seam will be in accordance with methods outlined in Chapter III, Volume I, of this Mining and Reclamation Plan.

Reclamation and Revegetation

When building and final site preparation have been completed, the soil will be revegetated to prevent erosion and any disturbed areas no longer needed for the conduct of mining operations will be immediately reclaimed and revegetated.

Upon completion of mining operations in the Aberdeen Seam, all disturbed areas will be returned, in a timely manner, to conditions they were capable of supporting before any mining began. As this is an underground mine with minimal surface disturbance, reclamation will not be complicated. The terrain will be returned to as nearly the original as practical.

Reclamation will be accomplished according to the methods outlined in Volume I, Chapter III, Part E.

Revegetation will be accomplished according to the methods outlined in Volume I, Chapter IV, Part D-5.

1987

Reclamation Cost Projection

Centennial Project

Lower Sunnyside Mine

Restoration to pre-mining land use will require:

	Job Description	Equipment	Hours	Cost
1.	Coal Pile Storage Area			
	a. Seal portals, remove conveyor, etc.	Loader	8	$ 640
	b. Fill pad	Loader	55	4,400
	c. Contour slope	D-7	30	2,400
	d. Compact	Loader	15	1,200
	e. Replace topsoil	Loader	23	1,840
	f. Grade topsoil	Grader	15	1,050
	g. Revegetate	Drill	7	350
	h. Stake	Engineer	14	700
	Total Coal Pile Area:			$12,580
2.	Roads			
	a. Recontour	D-7	5	$ 400
	b. Compact	Loader	3	240
	c. Replace topsoil	Loader	2	160
	d. Grade topsoil	Grader	2	140
	e. Revegetate	Drill	1	50
	Total Roads:			$ 990
3.	Seal Wells (2)			
	a. Fill, cement		6	$ 800
	Total Wells:			$ 800
4.	Material Storage Area (including topsoil pile			
	a. Remove all structures	5 man crew	120	$ 9,000
	b. Recontour	D-7	16	1,280
	c. Compact	Loader	4	320
	d. Replace topsoil	Loader	8	640
	e. Grade topsoil	Grader	4	280
	f. Revegetate	Drill	2	100
	g. Stake	Engineer	14	700
	Total Material Storage:			$12,320

Gilson (Pinnacle Mine)

Restoration to the pre-mining land use will require:

	Job Description	Equipment	Hours	Cost
1.	Mine Portal area			
	a. Seal portals, remove conveyor, etc.	Loader	8	$ 640
	b. Fill pad	Loader	12	960
	c. Contour slope	D-7	8	640
	d. Compact	Loader	4	320
	e. Replace topsoil	Loader	6	480
	f. Grade Topsoil	Grader	4	280
	g. Revegetate	Drill	2	100
	h. Stake slope	Engineer	4	200
	Total Portal:			$ 3,620
2.	Roads (1 mile)			
	a. Recontour	D-7	20	$ 1,600
	b. Compact	Loader	10	800
	c. Topsoil	Loader	8	640
	d. Grade	Grader	8	560
	e. Revegetate	Drill	4	200
	Total Roads:			$ 3,800
3.	Coal Pile Area			
	a. Fill pad	Loader	16	$ 1,280
	b. Contour slope	D-7	8	640
	c. Compact	Loader	4	320
	d. Topsoil	Loader	6	480
	e. Grade	Grader	4	280
	f. Revegetate	Drill	2	100
	g. Stake	Engineer	4	200
	Total Stockpile Area:			$ 3,300
4.	Seal Wells			
	a.		8	$ 1,000
	Fill, cement		8	
	Total Wells:			$ 1,000
5.	Material Storage & Building Areas			
	a. Remove all structures	5 man crew	120	$13,500
	b. Recontour	D-7	16	1,280
	c. Compact	Loader	4	320
	d. Replace topsoil	Loader	8	640
	e. Grade	Grader	4	280
	f. Revegetate	Drill	2	100
	Total Material:			$16,120

Aberdeen Mine

Restoration to the pre-mining land use will require:

	Job Description	Equipment	Hours	Cost
1.	Mine Portal Area			
	a. Seal portals, remove conveyor, etc.	Loader	8	$ 640
	b. Fill pad	Loader	24	1,920
	c. Contour slope	D-7	16	1,280
	d. Compact	Loader	8	640
	e. Replace topsoil	Loader	12	960
	f. Grade topsoil	Grader	8	560
	g. Revegetate	Drill	4	200
	h. Stake slope	Engineer	8	400
	Total Portal Area:			$ 6,600
2.	Coal Pile Area (including topsoil storage and sedimentation pond)			
	a. Fill pad	Loader	50	$ 4,000
	b. Contour slope	D-7	30	2,400
	c. Compact	Loader	15	1,200
	d. Replace topsoil	Loader	22	1,760
	e. Grade topsoil	Grader	15	1,050
	f. Revegetate	Drill	7	350
	g. Stake slope	Engineer	14	700
	Total Stockpile Area:			$ 11,460

Office Site

Restoration to pre-mining land use will require:

	Job Description	Equipment	Hours	Cost
1.	Office Site			
	a. Remove structures	5 man crew	50	$ 3,750
	b. Recontour	D-7	8	640
	c. Compact	Loader	4	320
	d. Replace topsoil	Loader	4	320
	e. Grade topsoil	Grader	4	280
	f. Revegetate	Drill	2	100
	g. Stake slope	Engineer	4	200
	Total Office Site:			$ 5,610
2.	Seal Well (1)			
	a. Fill, cement		4	$ 400
	Total Well:			$ 400
3.	Roads 1/4 Mile			
	a. Recontour	D-7	5	$ 400
	b. Compact	Loader	3	240
	c. Replace topsoil	Loader	2	160
	d. Grade topsoil	Grader	2	140
	e. Revegetate	Drill	1	50
	Total Roads:			$ 990

Total Projected Reclamation Costs:

Lower Sunnyside Mine	$26,690	
Gilson (Pinnacle) Mine	27,840	
Aberdeen Mine	18,060	
Office Site	7,000	
	$79,590	1987

IV. Environmental Resources

A. Geology

1. Introduction

The proposed permit area is in Book Cliffs which is the major physiographic feature in the region. The cliffs rise from a base at approximately 5,500 feet in elevation, to over 8,500 feet. Numerous canyons dissect the Book Cliffs. Soldier Creek and Coal Creek are the major area drainages. The permit area exhibits extreme topographic relief and is mountainous with steep cliffs and deeply incised drainages. With the exception of the Mancos Shale Formation, Fiasco, Deadman, and Straight Canyons exhibit similar stratigraphic and topographic characteristics.

2. Geologic Description of the General Area (Plate 21)

2.1 Tectonic Setting

The major coal seams of the Book Cliffs Coal Field lie within the Cretaceous Mesa Verde group which overlies the thick shales of the Cretaceous Mancos formation. The Mesa Verde group consists of the Star Point Sandstone, Blackhawk formation and Price River formation. The major coal seams lie within the Blackhawk formation.

The Tertiary Wasatch and Green River formations, along with the Price River formation, form the Roan Cliffs, the Tavaputs Plateau and the southern rim of the Uintah Basin. Lithologies present include fluvial, deltaic, and marine sandstones, mudstones, and shales.

2.2 Geologic History

During the Triassic and Jurassic periods, the area of the Book Cliffs was relatively stable, but gradually subsided and received sediments. The area, assumed to have been a relatively flat lowland, was occasionally covered by a shallow sea of short geologic duration. A thick red bed sequence suggests tropical conditions and the great thickness of sand accumulation suggests acid conditions. During Triassic times, the sediments probably came from all directions but, during the Jurassic time, the major source areas lay to the south and west.

During the early Cretaceous time, a trough developed in the Colorado Rockies area and the sea invaded. Gradually the sea crept westward as the trough continued to subside, reaching the east edge of the Colorado Plateau by the beginning of the Upper Cretaceous age.

Unconformities and thinning of various members indicate that volcanic activity to the west caused sediments to fill the basin faster than it could subside, causing the shoreline to be pushed eastward. When lulls in this activity developed, the incoming sediments diminished and the sea moved westward once more. With each pulse, the boundaries of the depositional environments moved eastward and then returned westward. The sandstone tongues of the Mesa Verde, which project into the Mancos, were deposited at these times.

After the sea retreated, the area continued to receive sediments under continental conditions which lasted well into Eocene time. In Oligocene time the area began to rise in earnest. Erosion attacked the newly formed formation creating the present mountain ranges and cliffs.

2.3 Stratigraphy

The main coal bearing beds in the region occur in the Blackhawk formation. There are various more or less distinct coal beds or zones as listed below from top to bottom according to stratigraphic position.

Upper Sunnyside Bed
Lower Sunnyside Bed
Rock Canyon Bed
Fishcreek Bed
Gilson Bed
Kenilworth Bed
Castlegate "B" Bed
Castlegate "A" Bed

These zones are lenticular and reach mineable thickness only in certain areas. The Lower Sunnyside Bed is the major bed in the area.

2.4 Structure

The Book Cliffs are basically a homocline (dip slope) dipping into the Uintah Basin with the cliff front roughly paralleling the strike of the feature. The strike of the beds is generally parallel to the face of the Book Cliffs. The beds are mostly uniform with dips of from 3° to 8° to the north and northeast toward the Uintah Basin.

Occasional faults cut the coal measures but are of small displacement and have been of little consequence in mining. The most serious group of faults lies in the Sunnyside area. These faults, which have a maximum separation of 200 feet, effect mining, but, fortunately, are not closely spaced.

2.5 History of Mining

Mining has been the major industry in the region for many years.

Coal was discovered in the Wasatch Plateau in 1874 and exploration soon spread to the Book Cliffs. Mines began operating in the area in 1889. The Castlegate and Sunnyside area was first developed, the areas in between being developed later. Coal was usually discovered away from settled areas and towns were built for employees by the companies.

Production from mines generally increased until 1920, but began to decline in the 1920's and 1930's. World War II brought production back to the 1920 levels and production continued to increase until 1957 when production again declined.

Book Cliff mines to present have produced about 75 percent of Utah's coal annually. Well over 200 million tons of coal have been extracted from the coal measures of the area. Much coal remains and numerous mines are presently operating in the area.

2.6 Geologic Hazard

There are occasional faults cutting the coal measures of the area. They are of relatively small displacement. The most serious faults occur in the Sunnyside area. There is no indication of faulting within our lease area.

Faults in the Sunnyside district of the Book Cliffs field have been thought, by some, to have a causative relationship to the bounces experiences there. The outcrops on the lease premises and our own aerial photos have been carefully studied. In our judgement, no faults cut the lease area. The bulk of the tonnage to be mined is under less than 1,500 feet of cover, with only a very limited amount of coal under cover, up to 2,200 feet.

Water inflows have never been a problem in the Book Cliffs field. The dip of the coal measures prevents entrapment of personnel, in any event.

3. <u>Geologic Description of the Mine Plan and Adjacent Areas</u>

3.1 General Description (Plate 21)

3.1-1 Stratigraphy

The coal seams in the Blackhawk formation are listed stratigraphically:

Upper Sunnyside Bed
Lower Sunnyside Bed
Rock Canyon Bed
Fishcreek Bed
Gilson Bed
Kenilworth Bed
Castlegate "B" Bed
Castlegate "A" Bed (Aberdeen)

Only the Lower Sunnyside, Gilson, and Castlegate "A" beds are formed in commercial thickness on the Centennial Property.

Stratigraphic sections of the coal beds are shown in Figures IV-1, IV-2, and IV-3. Seam Isopachs are shown on Plates 26, 27 and 28.

3.1-2 Structure

The structure between Deadman and Soldier Canyons is relatively simple. Structure contours are aligned basically east-west. The coal beds dip northward at approximately six degrees. No faults are thought to exist in the Deadman Canyon area.

3.1-3 History of Mining

Several small operations have mined a considerable amount of coal over the past 70 years in the Deadman Canyon Area. Mining ceased in the area in 1964. These mines, however, merely scratched the surface of the reserve. The remaining recoverable reserve is estimated to be greater than twenty-eight million tons and ranging in cover from 0 to 2,200 feet. Also refer to Part H, Section 3, re Past Mining.

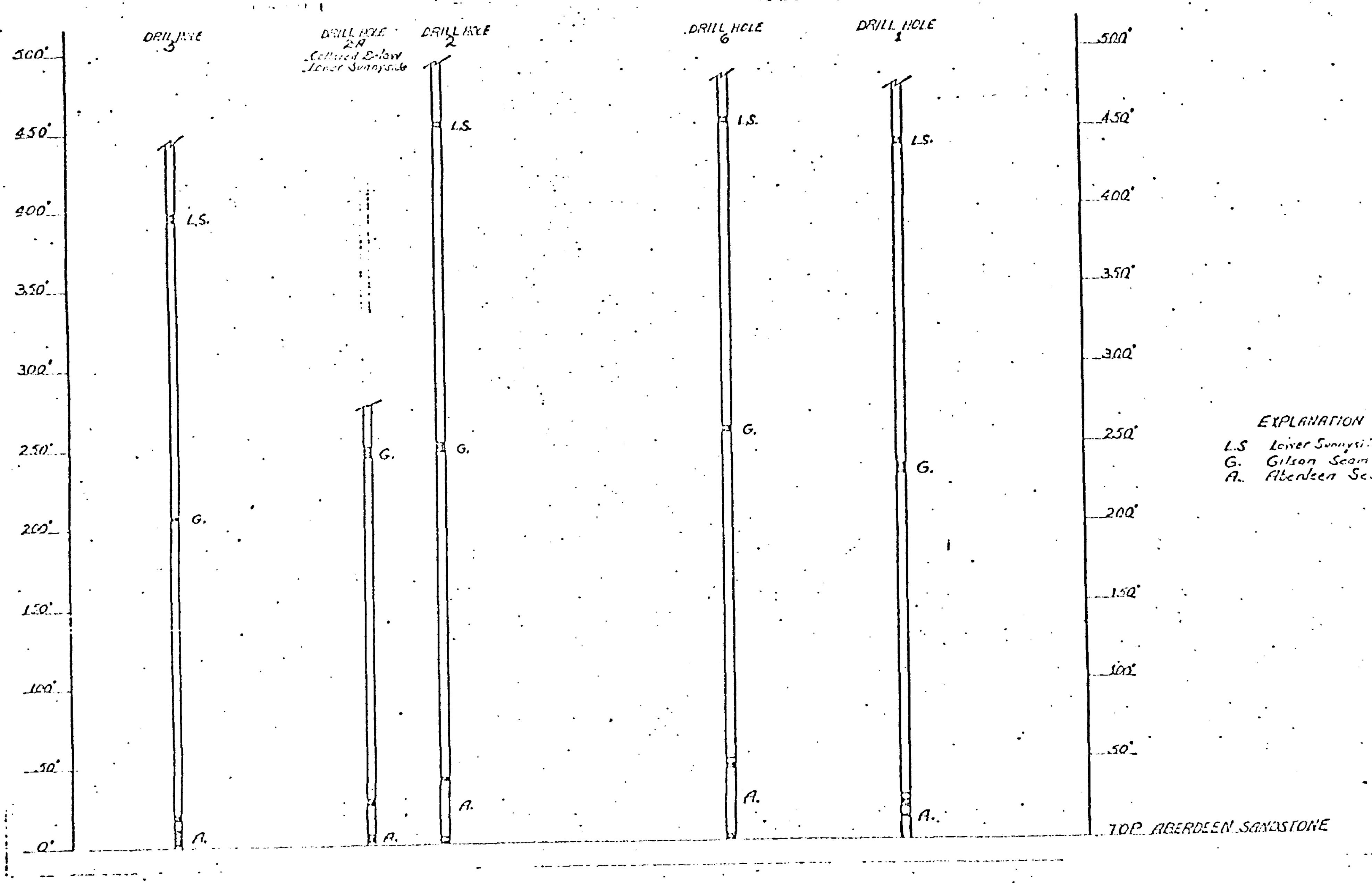


Figure IV-1
Stratigraphic Sections

GEOLOGIC COLUMN OF DEADMAN CANYON

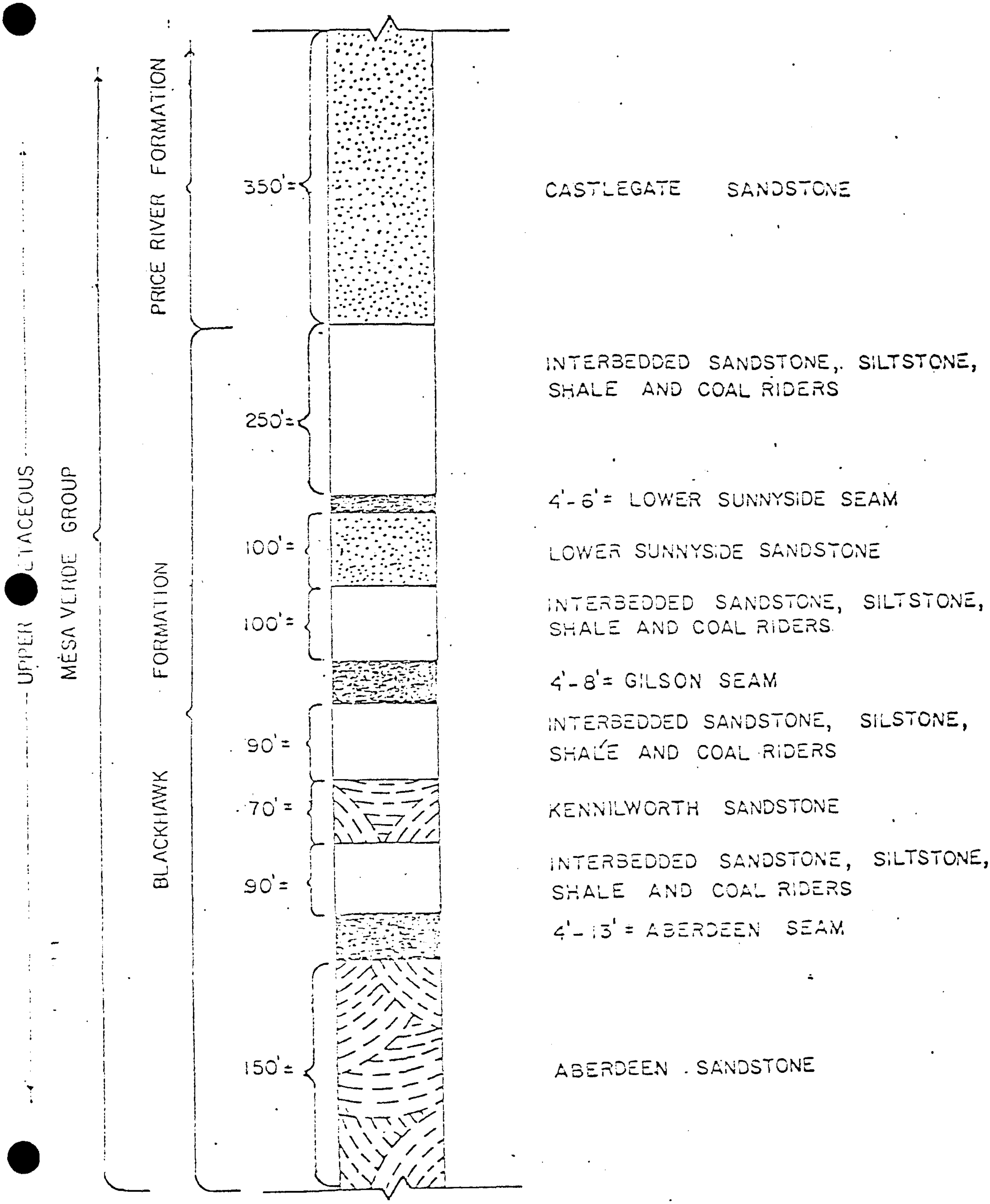
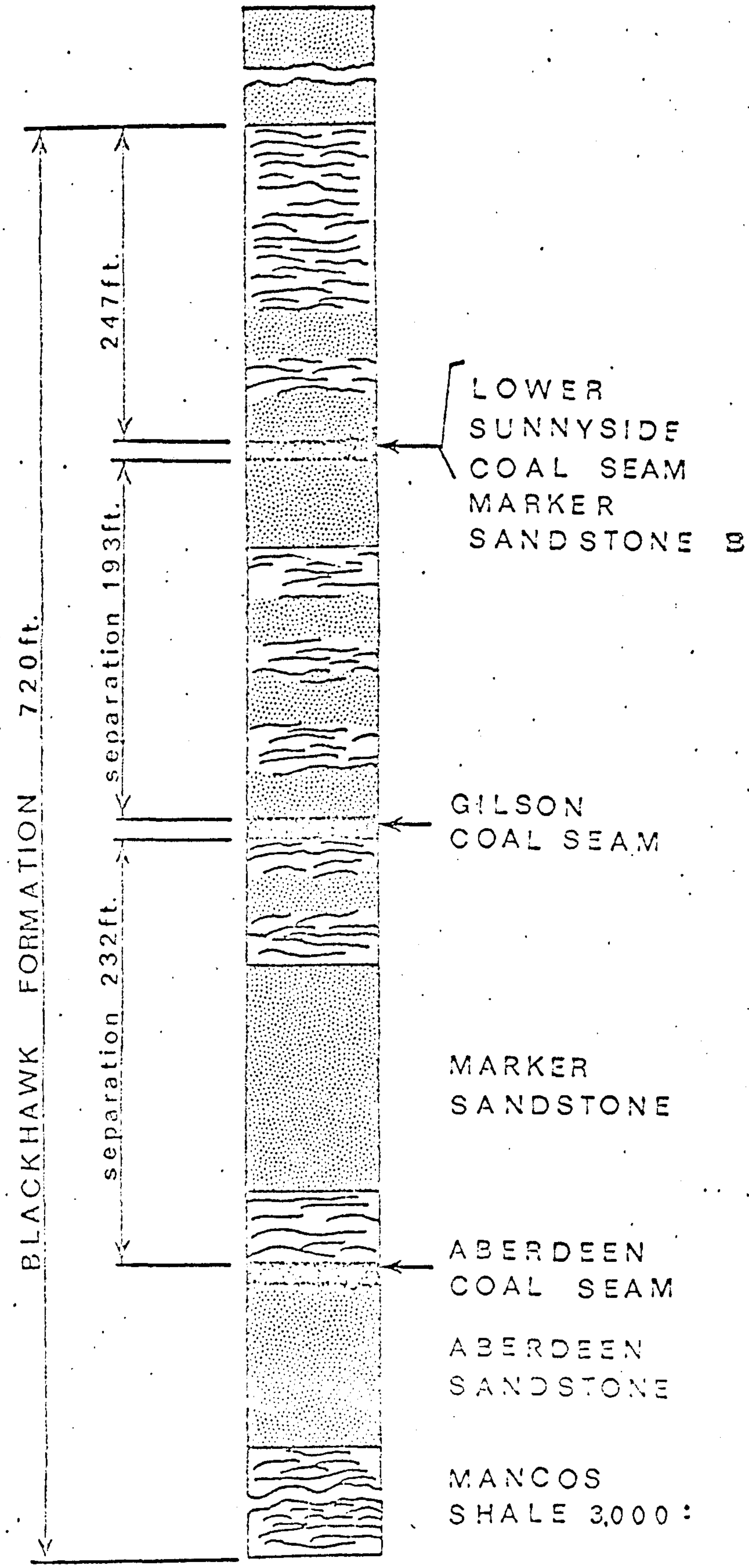


FIGURE IV-2



MEASURED SECTION OF THE BLACKHAWK FORMATION

DEADMAN CANYON NO SCALE

Figure IV-3

3.2 Detailed Description of Strata to be Disturbed by Surface Operations

3.2-1 Identification of Strata

Strata disturbed by surface operations consist of sandstone and siltstone of a colluvial nature.

3.2-2 Design of Boring and Sampling Program

3.2-2.1-1 Sites - Numbers, Location and Relationship to Disturbed Area

The number, locations, and relationship of drill holes and sampling are indicated on Plates 26, 27 and 28.

3.2-2.1-2 Methodology - Sample Collection, Compositing of Samples for Each Strata, Laboratory Analysis

Samples of the immediate floor and roof below and above each seam was sampled using conventional core drilling equipment. Also, samples of the overburden which was disturbed in surface operation has been sampled by "grab" methods, as well as auger drilling.

3.2-2.2 Data:

3.2-2.2-1 Field Log and Description of Samples - Lithologic Classification, Description, and Hydrologic Aspects

In November and December, 1971, a five-hole drilling program was conducted by Centennial Coal Associates, supplemented by mine samples and outcrop information, and the results used to estimate the coal reserves of the leases. Pertinent information on these drill holes is given in Table IV-1 and Appendix E. Complete lithologic logs of each drill hole are included in Appendix E. Numerous samples were taken from the outcrops of the Lower Sunnyside, Gilson, and Aberdeen seams, as well as from mine faces in the Hileman, Olsen, Star Point, and Blue Flame No. 1 mines. Information from those samples as well as the location of the drill holes is shown on Plates 26, 27 and 28.

In October and November, 1977, a seven-hole drilling program was conducted by Tower in order to better define the coal reserves for mine planning on the Zion's fee. Pertinent information on these drill holes is presented in Table IV-2. Complete lithologic logs of each drill hole are included in Appendix E. Locations are indicated on Plates 26, 27 and 28.

TABLE IV-1

Centennial Drill Holes

Number	Location	Total Depth	Coal Seams
DH-1	NW¼ NW¼ SE¼ Sec. 8 T13S, R11E, SLBM Elevation - 7230 ft.	516 ft.	Lower Sunnyside Gilson Aberdeen
DH-2	SW¼ NW¼ NW¼ Sec. 7 T13S, R11E, SLBM Elevation - 7275 ft.	580 ft.	Lower Sunnyside Gilson Aberdeen
DH-2-A	SW¼ NW¼ SE¼ Sec. 7 T13S, R11E, SLBM Elevation - 7165 ft.	303 ft.	Gilson Aberdeen
DH-5	SE¼ SW¼ NE¼ Sec. 7 T13S, R11E, SLBM Elevation - 7275 ft.	832 ft.	Lower Sunnyside Gilson Aberdeen
DH-6	NW¼ SE¼ SW¼ Sec. 5 T13S, R11E, SLBM Elevation - 8558 ft.	2275 ft.	Lower Sunnyside Gilson Aberdeen

TABLE IV-2

ANDALEX Drill Holes

Number	Location	Total Depth	Coal Seams
77-1-CP	NE¼ SE¼ SW¼ Sec. 7 T13S, R11E, SLBM Elevation - 7555 ft.	675 ft.	Gilson Aberdeen
77-2-CP	SE¼ NE¼ SW¼ Sec. 7 T13S, R11E, SLBM Elevation - 7520 ft.	690 ft.	Gilson Aberdeen
77-3-CP	SE¼ SE¼ NW¼ Sec. 7 T13S, R11E, SLBM Elevation - 7425 ft.	868 ft.	Lower Sunnyside Gilson Aberdeen
77-4-CP	SE¼ SE¼ SW¼ Sec. 7 T13S, R11E, SLBM Elevation - 7070 ft.	105 ft.	Aberdeen
77-5-CP	SE¼ SE¼ SW¼ Sec. 7 T13S, R11E, SLBM Elevation - 7085 ft.	85 ft.	Aberdeen
77-6-CP	NE¼ NE¼ NW¼ Sec. 18 T13S, R11E, SLBM Elevation - 7080 ft.	80 ft.	Aberdeen
77-7-CP	NE¼ NE¼ NW¼ Sec. 18 T13S, R11E, SLBM Elevation - 7010 ft.	45 ft.	Aberdeen

Andalex has also acquired lithologic logs of two drill holes completed by North American Coal Corp., in 1948. Although these holes are not located within the permit area, but to the west of its boundary, the information has been utilized in estimating reserves. Pertinent information is given in Table IV-3. Complete lithologic logs are included in Appendix E. and their location is indicated on Plates 26, 27 and 28 .

3.2-2.2-2 Laboratory Analysis - Chemical Acidity, Toxicity, Alkalinity, and Physical (Erodibility and Compaction) Properties

Complete laboratory analysis included following page 63.

3.2-2.2-3 Identification of Potential Acid, Toxic or Alkaline Producing Horizons

Refer to Appendix E and the laboratory analysis

3.2-2.2-4 Location of Subsurface Water at Face-Up Areas

No water was encountered at face-up areas.

3.3 Description of Coal Seams and Overburden Mine Plan

3.3-1 General Description

3.3-1.1 Stratigraphy

There are three coal seams of mineable thickness in the mine plan area. All three are part of the Blackhawk Formation of the Cretaceous Mesa Verde Group. The Blackhawk consists of three members. Stratigraphically, from bottom to top, they are the Aberdeen Member, the Kenilworth Member, and the Sunnyside Member. See Figure IV-2.

The bottom coal seam is the Aberdeen (also known as the Castlegate "A" Seam). It is found in the Aberdeen Member of the Blackhawk. This coal seam rests directly on approximately 150 feet of basal sandstone. This sandstone is of littoral marine origin and is known as the Aberdeen Sandstone. The coal seam ranges from 4 feet to 13 feet in thickness over the property. Above the seam is approximately 90 feet of interbedded sandstone, siltstone, and carbonaceous shale containing coal riders.

TABLE IV-3

North American Drill Holes

Number	Location	Total Depth	Coal Seams
DH-NACC-6	SE¼ SE¼ SE¼ Sec. 1 T13S, R10E, SLBM Elevation - 7460 ft.	Approx. 1020 ft.	Lower Sunnyside Gilson Aberdeen
DH-NACC-7	SW¼ NE¼ SE¼ Sec. 12 T13S, R10E, SLBM Elevation - 7192 ft.		Gilson Aberdeen

The middle seam is the Gilson Seam and ranges in thickness from 4 feet to 8 feet over the property. The Gilson is part of the Kenilworth Member of the Blackhawk. Directly below the Gilson is approximately 90 feet of interbedded sandstone, siltstone, and carbonaceous shale with coal riders. Below this is approximately 70 feet of barrier beach sandstone known as the Kenilworth Sandstone. Above the Gilson is approximately 100 feet of interbedded sandstone, siltstone, shale, and coal riders.

The top seam in the Lower Sunnyside Seam, ranging from 4 feet to 6 feet in thickness. The Lower Sunnyside is part of the Sunnyside Member of the Blackhawk. Below the coal seam is approximately 100 feet of barrier beach sandstone known as the Lower Sunnyside Sandstone. Above the coal seam is about 250 feet of interbedded sandstone, siltstone, shale, and coal riders.

Above the Blackhawk, the Castlegate Sandstone and Price River Formation of the Mesa Verde Group can be found over various parts of the property. The North Horn Formation is also present in certain areas of the property. Total overburden on the mine plan area ranges from 0 to 2,400 feet.

3.3-1.2 Structure

Structure contours are aligned basically east-west. The coal beds dip northward at approximately six degrees. No faults are known to exist in the mine plan area. Overburden ranges from 0 to 2,400 feet.

3.3-1.3 Hydrologic Aspects

All groundwater exists as perched aquifers in the mine plan area. Due to the lenticular nature of the geology in the area, any groundwater is isolated and very limited. Refer to Part B of this Chapter re Hydrology. (See recent quality data following page 86.)

3.3-1.4 Location of Subsurface Water

Some of the sandstone beds of the Blackhawk Formation are water bearing in the mine plan area. Most of the beds are dry however, and partially drained of water near the cliff faces. Groundwater is perched due to the lenticular geology and any groundwater is isolated. Also, any water bearing units are small in areal extent. Refer to Part B of this Chapter re Hydrology. The lowermost acquifer known in this area is the Aberdeen Sandstone, which is monitored below the lowermost coal seam.

1984

WATER QUALITY DATA

SAMPLE: 18-2 (MOUTH OF STAR POINT CANYON)

Date	1-24-84	5-10-84	8-10-84	12-7-84
Acidity as $CaCO_3$ (mg/1)		32.00		
Alkalinity, $CaCO_3$ (mg/1)		370		
Ammonia, NH_3N (mg/1)		1.35		N
Arsenic, As (mg/1)	NO	.008	NO	
Barium, Ba (mg/1)		.22		
Bicarbonate, HCO_3 (mg/1)		451.40		O
Boron as B (mg/1)		.160		
Cadmium, Cd (mg/1)	F	<.001	F	
Calcium, Ca (mg/1)		440.00		
Carbonate as CO_3 (mg/1)		<.01		F
Choloride, Cl (mg/1)	L	130	L	
Chromium, Cr (mg/1)		.020		
Conductivity umhos/cm	O	9,800	O	L
Copper Cu (mg/1)		.040		
Fluoride, F (mg/1)	W	.41	W	
Iron, Fe (Dis) (mg/1)		.02		O
Iron, Fe (mg/1)		.23		
Lead, Pb (mg/1)		.006		W
Magnesium, Mg (mg/1)		420.00		
Manganese, Mn (mg/1)		.09		
Mercury, Hg (mg/1)		<.0002		
Molybdenum as Mo (mg/1)		<.001		
Nitrate, NO_3N (mg/1)		.03		
Oil and Grease (mg/1)		<.1		
Phosphate PO_4P Ortho (mg/1)		.02		
Phosphate PO_4P (mg/1)		.04		
Potassium, K (mg/1)		21.0		
Selenium, Se (mg/1)		<.001		
Silver, Ag (mg/1)		<.0010		
Sodium, Na (mg/1)		950.00		
Sulfate, SO_4 (mg/1)		4,100		
Suspended Solids (mg/1)		24.0		
TDS (mg/1)		6350		
Total Kieldahl N (mg/1)		2.35		
Zinc, Zn (mg/1)		.070		
ph Units		7.90		

Total Settleable Solids   Cation Anion Balance

Total Hardness ($CaCO_3$)

1984

WATER QUALITY DATA

SAMPLE: 18-4

Date	1-24-84	5-10-84	8-10-84	12-7-84
Acidity as $CaCO_3$ (mg/1)		5.00		
Alkalinity, $CaCO_3$ (mg/1)		330	N	N
Ammonia, NH_3N (mg/1)	N	<.01		
Arsenic, As (mg/1)		<.001		
Barium, Ba (mg/1)		.09	O	O
Bicarbonate, HCO_3 (mg/1)	O	402.60		
Boron as B (mg/1)		.013		
Cadmium, Cd (mg/1)		<.001		
Calcium, Ca (mg/1)		80.00		
Carbonate as CO_3 (mg/1)		<.01	F	F
Choloride, Cl (mg/1)	F	12.4		
Chromium, Cr (mg/1)		.002		
Conductivity umhos/cm		1,200	L	L
Copper Cu (mg/1)	L	<.001		
Fluoride, F (mg/1)		.31		
Iron, Fe (Dis) (mg/1)		<.01	O	O
Iron, Fe (mg/1)	O	.05		
Lead, Pb (mg/1)		.003		
Magnesium, Mg (mg/1)		108.00	W	W
Manganese, Mn (mg/1)	W	<.01		
Mercury, Hg (mg/1)		<.0002		
Molybdenum as Mo (mg/1)		<.001		
Nitrate, NO_3N (mg/1)		.99		
Oil and Grease (mg/1)		<.1		
Phosphate PO_4P Ortho (mg/1)		<.02		
Phosphate PO_4P (mg/1)		3.20		
Potassium, K (mg/1)		3.7		
Selenium, Se (mg/1)		<.001		
Silver, Ag (mg/1)		<.0010		
Sodium, Na (mg/1)		32.00		
Sulfate, SO_4 (mg/1)		350		
Suspended Solids (mg/1)		34.0		
TDS (mg/1)		780		
Total Kieldahl N (mg/1)		.08		
Zinc, Zn (mg/1)		.010		
ph Units		7.80		

1984

WATER QUALITY DATA

SAMPLE: 7-1 (DEADMAN CANYON N of DISTURBED AREA)

Date	1-24-84	5-10-84	8-10-84	12-7-84
Acidity as $CaCO_3$ (mg/1)		5.00		
Alkalinity, $CaCO_3$ (mg/1)	N	295	N	N
Ammonia, NH_3N (mg/1)		<.01		
Arsenic, As (mg/1)		<.001	O	O
Barium, Ba (mg/1)	O	.10		
Bicarbonate, HCO_3 (mg/1)		359.90		
Boron as B (mg/1)		.020		
Cadmium, Cd (mg/1)		<.010		
Calcium, Ca (mg/1)	F	60.00	F	F
Carbonate as CO_3 (mg/1)		<.01		
Choloride, Cl (mg/1)		13.2		L
Chromium, Cr (mg/1)	L	<.001	L	
Conductivity umhos/cm		1,050		
Copper Cu (mg/1)		.020	O	O
Fluoride, F (mg/1)	O	.32		
Iron, Fe (Dis) (mg/1)		<.01		
Iron, Fe (mg/1)		.08		W
Lead, Pb (mg/1)	W	.004	W	
Magnesium, Mg (mg/1)		100.80		
Manganese, Mn (mg/1)		.07		
Mercury, Hg (mg/1)		<.0002		
Molybdenum as Mo (mg/1)		<.001		
Nitrate, NO_3N (mg/1)		.10		
Oil and Grease (mg/1)		<.1		
Phosphate PO_4P Ortho (mg/1)		<.02		
Phosphate PO_4P (mg/1)		.08		
Potassium, K (mg/1)		37		
Selenium, Se (mg/1)		<.010		
Silver, Ag (mg/1)		<.0010		
Sodium, Na (mg/1)		31.00		
Sulfate, SO_4 (mg/1)		290		
Suspended Solids (mg/1)		26.0		
TDS (mg/1)		670		
Total Kieldahl N (mg/1)		.10		
Zinc, Zn (mg/1)		.050		
ph Units		7.70		

1984

WATER QUALITY DATA

SAMPLE: 18-3 (MOUTH OF LEFT FORK OF DEADMAN)

Date	1-24-84	5-10-84	8-10-84	12-7-84
Acidity as $CaCO_3$ (mg/1)			8.00	
Alkalinity, $CaCO_3$ (mg/1)		N	329	N
Ammonia, NH_3N (mg/1)	N		.02	
Arsenic, As (mg/1)			<.001	
Barium, Ba (mg/1)			.05	O
Bicarbonate, HCO_3 (mg/1)	O	O	401.40	
Boron as B (mg/1)			.020	
Cadmium, Cd (mg/1)			<.001	
Calcium, Ca (mg/1)			78.00	
Carbonate as CO_3 (mg/1)			<.01	F
Choloride, Cl (mg/1)	F	F	49.0	
Chromium, Cr (mg/1)			.020	
Conductivity umhos/cm			2000	L
Copper Cu (mg/1)	L	L	.022	
Fluoride, F (mg/1)			.35	
Iron, Fe (Dis) (mg/1)			.01	O
Iron, Fe (mg/1)		O	.15	
Lead, Pb (mg/1)	O		.090	
Magnesium, Mg (mg/1)			203.30	W
Manganese, Mn (mg/1)			.01	
Mercury, Hg (mg/1)	W	W	<.0002	
Molybdenum as Mo (mg/1)			<.001	
Nitrate, NO_3N (mg/1)			.35	
Oil and Grease (mg/1)			<.1	
Phosphate PO_4P Ortho (mg/1)			<.02	
Phosphate PO_4P (mg/1)			.06	
Potassium, K (mg/1)			9.50	
Selenium, Se (mg/1)			<.001	
Silver, Ag (mg/1)			<.001	
Sodium, Na (mg/1)			66.00	
Sulfate, SO_4 (mg/1)			710	
Suspended Solids (mg/1)			9.0	
TDS (mg/1)			1,325	
Total Kjeldahl N (mg/1)			.12	
Zinc, Zn (mg/1)			.038	
ph Units			8.07	

1984

WATER QUALITY DATA

SAMPLE: OUTFALL 006

Date	6-19-84	7-23-84	9-10-84	12-7-84
Acidity as $CaCO_3$ (mg/1)				
Alkalinity, $CaCO_3$ (mg/1)				
Ammonia, NH_3N (mg/1)				NO DISCHARGE
Arsenic, As (mg/1)				
Barium, Ba (mg/1)				
Bicarbonate, HCO_3 (mg/1)				
Boron as B (mg/1)				
Cadmium, Cd (mg/1)				
Calcium, Ca (mg/1)				
Carbonate as CO_3 (mg/1)				
Choloride, Cl (mg/1)				
Chromium, Cr (mg/1)				
Conductivity umhos/cm				
Copper Cu (mg/1)				
Fluoride, F (mg/1)				
Iron, Fe (Dis) (mg/1)				
Iron, Fe (mg/1)	0.05	<0.05	<0.05	
Lead, Pb (mg/1)				
Magnesium, Mg (mg/1)				
Manganese, Mn (mg/1)				
Mercury, Hg (mg/1)				
Molybdenum as Mo (mg/1)				
Nitrate, NO_3N (mg/1)				
Oil and Grease (mg/1)	0.5	<0.5	<0.5	
Phosphate PO_4P Ortho (mg/1)				
Phosphate PO_4P (mg/1)				
Potassium, K (mg/1)				
Selenium, Se (mg/1)				
Silver, Ag (mg/1)				
Sodium, Na (mg/1)				
Sulfate, SO_4 (mg/1)				
Suspended Solids (mg/1)	11.0	3.0	5.0	
TDS (mg/1)	2091	2035	2191	
Total Kjeldahl N (mg/1)				
Zinc, Zn (mg/1)				
ph Units	7.7	7.6	7.4	

1984

WATER QUALITY DATA

SAMPLE: WELL#1

Date	1-24-84	5-10-84	8-10-84	12-7-84
Acidity as $CaCO_3$ (mg/1)	30.0	28.00	10.00	12.00
Alkalinity, $CaCO_3$ (mg/1)	544	520	58.0	562.
Ammonia, NH_3N (mg/1)	0.80	1.50	.45	3.20
Arsenic, As (mg/1)	0.005	.004	<.001	<.001
Barium, Ba (mg/1)	0.15	.19	.02	.01
Bicarbonate, HCO_3 (mg/1)	663.68	634.00	70.80	685.70
Boron as B (mg/1)	0.240	.250	.031	.444
Cadmium, Cd (mg/1)	<0.001	<.001	<.001	.004
Calcium, Ca (mg/1)	180	220.00	58.00	220.00
Carbonate as CO_3 (mg/1)	<0.01	<.01	<.01	<.01
Choloride, Cl (mg/1)	158	160	109	132
Chromium, Cr (mg/1)	0.021	.025	.010	.003
Conductivity umhos/cm	2650	3000	21,000	3,000
Copper Cu (mg/1)	0.010	.030	.022	.110
Fluoride, F (mg/1)	0.40	.28	.20	.40
Iron, Fe (Dis) (mg/1)	0.16	.04	.95	.11
Iron, Fe (mg/1)	36.85	138.20	1.20	52.00
Lead, Pb (mg/1)	0.003	.002	.110	.002
Magnesium, Mg (mg/1)	216	252.00	206.40	210.00
Manganese, Mn (mg/1)	0.28	.47	.16	.30
Mercury, Hg (mg/1)	<0.0002	<.0002	<.0002	<.0002
Molybdenum as Mo (mg/1)	<0.001	<.001	<.001	.003
Nitrate, NO_3N (mg/1)	0.60	.16	.03	.11
Oil and Grease (mg/1)	<0.2	<.1	<.1	7.8
Phosphate PO_4P Ortho (mg/1)	0.06	<.02	<.02	.02
Phosphate PO_4P (mg/1)	0.30	.08	.08	.24
Potassium, K (mg/1)	12.8	12.3	12.00	12.60
Selenium, Se (mg/1)	0.002	<.001	<.001	<.001
Silver, Ag (mg/1)	<0.001	<.0010	<.001	<.0010
Sodium, Na (mg/1)	58.00	68.00	72.50	140.00
Sulfate, SO_4 (mg/1)	750	930	868	206
Suspended Solids (mg/1)	36.0	113	104	103
TDS (mg/1)	1730	1,998	1,420	1,920
Total Kieldahl N (mg/1)	1.15	2.50	.65	3.85
Zinc, Zn (mg/1)	0.56	1.290	16.500	8.500
ph Units	7.4	7.70	8.30	7.00

ANDALEX
RESOURCES, INC.
Tower Division

M E M O R A N D U M

TO: DOGM, General Inspection, File

FROM: Michael W. Glasson

DATE: October 5, 1987

SUBJECT: 1987 3rd Quarter Water Monitoring

WATER MONITORING	3RD QUARTER, 1987
7-1	No Flow
801	No Flow
S18-1	No Flow
18-2	No Flow
18-3	No Flow
18-4	No Flow
S25-1	Analysis Attached
25-2	No Flow
Well #1	Analysis Attached

MWG/amr

MOUNTAIN STATES ANALYTICAL

ANALYTICAL REPORT

CLIENT: Andalex Resources
P.O. Box 902
Price, Utah 84501

LAB NO: 2748
DATE REC'D: 09/09/87
DATE SAMPLED: 09/03/87

ATTN: Mr. Mike Glasson

SAMPLE ID: Well #1

CHEMICALS:	RESULT AS RECEIVED		METALS:	RESULT AS RECEIVED	
Acidity	0	mg/lCaCO3	Arsenic	<0.002	mg/l
Alkalinity, Total	618	mg/lCaCO3	Barium	<0.10	mg/l
Alkalinity, Carbonate	0	mg/lCaCO3	Boron	0.65	mg/l
Chloride	663.5	mg/l	Cadmium	<0.002	mg/l
Conductivity	4,040	umhos/cm	Calcium	296.0	mg/l
Fluoride	0.40	mg/l	Chromium	<0.05	mg/l
Nitrogen, Ammonia	<0.50	mg/l	Copper	<0.03	mg/l
Nitrogen, Nitrate	<0.05	mg/l	Iron	0.58	mg/l
Oil & Grease	<2.0	mg/l	Lead	<0.05	mg/l
pH	7.05	Units	Magnesium	407.4	mg/l
Phosphorus, Ortho	<0.05	mg/l	Manganese	0.17	mg/l
Phosphorus, Total	<0.05	mg/l	Mercury	<0.50	ug/l
Solids, Total Dissolved	3,360	mg/l	Potassium	17.9	mg/l
Solids, Total Suspended	<5.0	mg/l	Selenium	<0.005	mg/l
Sulfate	1,000	mg/l	Sodium	113.2	mg/l
TKN	<1.0	mg/l	Diss. Iron	0.31	mg/l
			Molybdenum	<0.10	mg/l
			Silver	<0.01	mg/l
Total Anions	53.68	meq/l	Zinc	<0.01	mg/l
Total Cations	52.32	meq/l			

Supervisor: [signature]
Reviewed and approved: 09/10/87

Respectfully submitted,

[signature]

Ray A. Sim, Director

MOUNTAIN STATES ANALYTICAL

ANALYTICAL REPORT

CLIENT: Andalex Resources
P.O. Box 902
Price, Utah 84501

LAB NO: 2747
DATE REC'D: 09/09/87
DATE SAMPLED: 09/03/87

ATTN: Mr. Mike Glasson

SAMPLE ID: ~~525-1~~ S25-1

CHEMICALS:	RESULT AS RECEIVED		METALS:	RESULT AS RECEIVED	
Acidity	0	mg/lCaCO3	Arsenic	<0.002	mg/l
Alkalinity, Total	480	mg/lCaCO3	Barium	<0.10	mg/l
Alkalinity, Carbonate	0	mg/lCaCO3	Boron	0.30	mg/l
Chloride	35.0	mg/l	Cadmium	<0.002	mg/l
Conductivity	1,870	umhos/cm	Calcium	166.0	mg/l
Fluoride	0.46	mg/l	Chromium	<0.05	mg/l
Nitrogen, Ammonia	<0.50	mg/l	Copper	<0.03	mg/l
Nitrogen, Nitrate	0.06	mg/l	Iron	0.11	mg/l
Oil & Grease	<2.0	mg/l	Lead	<0.05	mg/l
pH	7.82	Units	Magnesium	183.6	mg/l
Phosphorus, Ortho	<0.05	mg/l	Manganese	0.04	mg/l
Phosphorus, Total	<0.05	mg/l	Mercury	<0.50	ug/l
Solids, Total Dissolved	1,604	mg/l	Potassium	12.7	mg/l
Solids, Total Suspended	<5.0	mg/l	Selenium	<0.005	mg/l
Sulfate	711	mg/l	Sodium	49.3	mg/l
TKN	<1.0	mg/l	Diss. Iron	<0.05	mg/l
			Molybdenum	<0.10	mg/l
			Silver	<0.01	mg/l
Total Anions	25.87	meq/l	Zinc	0.01	mg/l
Total Cations	25.40	meq/l			

Supervisor: [signature]
Reviewed and approved: 09/30/87

Respectfully submitted,
[signature]
Ray A. Sim, Director

ANDALEX
RESOURCES, INC.
Tower Division

MEMORANDUM

TO: DOGM, General Inspection, File

FROM: Michael W. Glasson

DATE: July 9, 1987

SUBJECT: 1987 2nd Quarter Water Monitoring

WATER MONITORING 2ND QUARTER, 1987

7-1	No Flow
8-1	No Flow
S18-1	No Flow
18-2	No Flow
18-3	No Flow
18-4	No Flow
S25-1	No Flow
25-2	No Flow
Well #1	Analysis Attached

MWG/amr

MOUNTAIN STATES ANALYTICAL

ANALYTICAL REPORT

CLIENT: Andalex Resources
P.O. Box 902
Price, Utah 84501

LAB NO: 2073
DATE REC'D: 6-19-87
DATE SAMPLED: 6-18-87

ATTN: Mr. Mike Glasson

SAMPLE ID: Well #1

ANALYSIS	RESULT AS RECEIVED		METALS:	RESULT AS RECEIVED	
Acidity	0	mg/l $CaCO_3$	Arsenic	<0.002	mg/l
Alkalinity, Total	630	mg/l $CaCO_3$	Barium	<0.10	mg/l
Alkalinity, Bicarbonate	769	mg/l HCO_3	Boron	0.63	mg/l
Alkalinity, Carbonate	0	mg/l $CaCO_3$	Cadmium	<0.002	mg/l
Chloride	578.7	mg/l	Calcium	376	mg/l
Conductivity	3,875	umhos/cm	Chromium	<0.05	mg/l
Nitrogen, Ammonia	<0.50	mg/l	Copper	<0.03	mg/l
Nitrogen, Nitrate	<0.05	mg/l	Iron	0.07	mg/l
Oil & Grease	<2.0	mg/l	Lead	<0.05	mg/l
pH	6.94	Units	Magnesium	341.7	mg/l
Phosphorus, Ortho	<0.05	mg/l	Manganese	0.18	mg/l
Phosphorus, Total	<0.05	mg/l	Mercury	<0.50	ug/l
Solids, Total Dissolved	3,110	mg/l	Potassium	18.6	mg/l
Solids, Total Suspended	<5.0	mg/l	Selenium	<0.005	mg/l
Sulfate	52.26	mg/l	Sodium	113.0	mg/l
Cyanide, Total	<0.05	mg/l	Zinc	0.01	mg/l
TKN	<1.0	mg/l	Diss. Iron	0.05	mg/l
Fluoride	0.40	mg/l	Silver	<0.01	mg/l
			Molybdenum	<0.10	mg/l

Supervisor: [signature]
Reviewed and approved: 06/30/87

Respectfully submitted,

Ray A. Sim, Director

ANDALEX
RESOURCES, INC.
Tower Division

M E M O R A N D U M

TO: DOGM, General Inspection, File

FROM: Michael W. Glasson

SUBJECT: 1987 1st Quarter Water Monitoring

WATER MONITORING 1ST QUARTER, 1987

7-1	No Flow
8-1	No Flow
S18-1	No Flow
18-2	No Flow
18-3	No Flow
18-4	No Flow
S25-1	No Flow
25-2	No Flow
Well #1	Analysis Attached

MOUNTAIN STATES ANALYTICAL

ANALYTICAL REPORT

CLIENT: Andelex Resources
P.O. Box 902
Price, Utah 84501

ATTN: Mike Glasson

JOB NO: 1416
DATE REC'D: 3-10-87
DATE SAMPLED: 3-06-87
P.O. #:

SAMPLE ID: Well #1

Acidity	0	mg/l $CaCO_3$	Arsenic	<0.002	mg/l
Alkalinity, Total	643	mg/l $CaCO_3$	Barium	<0.10	mg/l
Alkalinity, Carbonate	784	mg/HCO_3	Boron	0.75	mg/l
Chloride	250.0	mg/l	Cadmium	<0.002	mg/l
Conductivity	3,500	mg/l	Calcium	272.0	mg/l
Fluoride	0.41	mg/l	Chromium	<0.05	mg/l
Nitrogen, Ammonia	<0.50	mg/l	Copper	<0.03	mg/l
Nitrogen, Nitrate	<0.05	mg/l	Iron	0.06	mg/l
Oil & Grease	2.1	mg/l	Lead	<0.05	mg/l
pH	6.85	mg/l	Magnesium	347.8	mg/l
Phosphorus, Ortho	<0.05	mg/l	Manganese	0.15	mg/l
Phosphorus, Total	<0.05	mg/l	Mercury	<0.50	ug/l
Solids, Total Dissolved	2,808	mg/l	Potassium	17.9	mg/l
Solids, Total Suspended	<5.0	mg/l	Selenium	<0.005	mg/l
Sulfate	1,350	mg/l	Sodium	114.0	mg/l
TKN	<1.0	mg/l	Zinc	0.02	mg/l
			Diss. Iron	<0.05	mg/l
Total Cations	47.66	meq/l	Molybdenum	<0.20	mg/l
Total Anions	48.04	meq/l	Silver	<0.01	mg/l

Supervisor: [signature]
Reviewed and approved: 4-02-87

Respectfully submitted,

[signature]

Ray A. Sim, Director

1645 West 2200 South Salt Lake City, Utah 84119 (801) 973-0050

ANDALEX
RESOURCES, INC.
Tower Division

M E M O R A N D U M

TO: DOGM, General Inspection, File

FROM: Michael W. Glasson

SUBJECT: 1986 4th Quarter Water Monitoring

WATER MONITORING 4TH QUARTER, 1986

7-1	No Flow
8-1	No Flow
S18-1	Analysis Attached
18-2	No Flow
18-3	No Flow
18-4	No Flow
S25-1	Analysis Attached
25-2	No Flow
Well #1	Analysis Attached

CERTIFICATE OF ANALYSIS

STANDARD LABORATORIES, INC.

P.O. Box 1140, Huntington, Utah 84528 801-653-2314

Lab. No. 8595

Date Rec'd 10-1-86

Date Sampled 9-30-86

Time Sampled

Client: ANDILEX RESOURCES
TOWER RESOURCES DIVISION
PO BOX 902
PRICE, UT 84501

Sample ID: 18-1

Acidity	<1.0	mg/l $CaCO_3$	Aluminum	—	mg/l
Alkalinity, Total	460	mg/l $CaCO_3$	Arsenic	<0.001	mg/l
Alkalinity, Bicarbonate	561	mg/l ~~$CaCO_3$~~ HCO_3	Barium	<0.1	mg/l
Alkalinity, Carbonate	<1.0	mg/l $CaCO_3$	Beryllium		mg/l
Chloride	260	mg/l	Boron	0.90	mg/l
Coliform, Fecal		MPN/100 ml	Cadmium	<0.005	mg/l
Coliform, Total		MPN/100 ml	Calcium	142	mg/l
Conductivity	3280	umhos/cm	Chromium	<0.05	mg/l
Fluoride		mg/l	Copper	0.02	mg/l
Hardness, Total		mg/l $CaCO_3$	Iron	<0.05	mg/l
Nitrogen, Ammonia	<0.05	mg/l	Lead	<0.05	mg/l
Nitrogen, Nitrate	0.27	mg/l	Magnesium	288	mg/l
Nitrogen, Nitrite		mg/l	Manganese	0.01	mg/l
Oil & Grease	<0.5	mg/l	Mercury	<0.2	ug/l
pH	7.40	Units	Nickel	<0.04	mg/l
Phosphorus, Ortho	0.02	mg/l	Potassium	21.5	mg/l
Phosphorus, Total	0.03	mg/l	Selenium	<0.005	mg/l
Solids, Total Dissolved	2140	mg/l	Silica		mg/l
Solids, Total Suspended	47.0	mg/l	Sodium	152	mg/l
Sulfate	1000	mg/l	Vanadium		mg/l
Sulfide		mg/l	Zinc	<0.005	mg/l
Turbidity		NTU	Iron (Diss.)	<0.05	mg/l
TKN	0.39	mg/l	Molybdenum	<0.2	mg/l
Total Cations	37.97	meq/l	Silver	<0.01	mg/l
Total Anions	37.37	meq/l			

Analyst: [signature]

Respectfully submitted [signature]

Certified Environmental Laboratory

CERTIFICATE OF ANALYSIS

STANDARD LABORATORIES, INC.

PO Box 1140, Huntington, Utah 84528 801-653-2314

Lab. No. 8594

Date Rec'd 10-1-86

Date Sampled 9-30-86

Time Sampled

Client: ANDILEX RESOURCES
TOWER DIVISION
PO BOX 902
PRICE, UT 84501

Sample ID: HOFFMAN

Acidity	<1.0	mg/l $CaCO_3$
Alkalinity, Total	289	mg/l $CaCO_3$
Alkalinity, Bicarbonate	353	mg/l ~~$CaCO_3$~~ HCO_3
Alkalinity, Carbonate	<1.0	mg/l $CaCO_3$
Chloride	15	mg/l
Coliform, Fecal		MPN/100 ml
Coliform, Total		MPN/100 ml
Conductivity	905	umhos/cm
Fluoride		mg/l
Hardness, Total		mg/l $CaCO_3$
Nitrogen, Ammonia	<0.05	mg/l
Nitrogen, Nitrate	0.08	mg/l
Nitrogen, Nitrite		mg/l
Oil & Grease	1.2	mg/l
pH	7.75	Units
Phosphorus, Ortho	0.04	mg/l
Phosphorus, Total	0.04	mg/l
Solids, Total Dissolved	505	mg/l
Solids, Total Suspended	2.0	mg/l
Sulfate	160	mg/l
Sulfide		mg/l
Turbidity		NTU
TKN	0.18	mg/l
Total Cations	9.58	meq/l
Total Anions	9.54	meq/l

Aluminum		mg/l
Arsenic	<0.001	mg/l
Barium	<0.1	mg/l
Beryllium		mg/l
Boron	0.17	mg/l
Cadmium	<0.005	mg/l
Calcium	52	mg/l
Chromium	<0.05	mg/l
Copper	0.02	mg/l
Iron	<0.05	mg/l
Lead	<0.05	mg/l
Magnesium	64	mg/l
Manganese	<0.01	mg/l
Mercury	<0.2	ug/l
Nickel	<0.04	mg/l
Potassium	4.5	mg/l
Selenium	<0.005	mg/l
Silica		mg/l
Sodium	36	mg/l
Vanadium		mg/l
Zinc	<0.005	mg/l
Iron (Diss.)	<0.05	mg/l
Molybdenum	<0.2	mg/l
Silver	<0.01	mg/l

Analyst: [signature]

Respectfully submitted [signature]

Certified Environmental Laboratory

CERTIFICATE OF ANALYSIS

STANDARD LABORATORIES, INC.
P.O. Box 1140, Huntington, Utah 84528 801-653-2314

Lab. No. 8593
Date Rec'd 10-1-86
Date Sampled 9-30-86
Time Sampled ______

Client: ANDILEX RESOURCES
TOWER DIVISION
PO BOX 902
PRICE, UT 84501

Sample ID: WELL #1

Parameter	Result	Units
Acidity	<1.0	mg/l $CaCO_3$
Alkalinity, Total	612	mg/l $CaCO_3$
Alkalinity, Bicarbonate	747	mg/l ~~$CaCO_3$~~ HCO_3
Alkalinity, Carbonate	<1.0	mg/l $CaCO_3$
Chloride	252	mg/l
Coliform, Fecal		MPN/100 ml
Coliform, Total		MPN/100 ml
Conductivity	3200	umhos/cm
Fluoride		mg/l
Hardness, Total		mg/l $CaCO_3$
Nitrogen, Ammonia	<0.05	mg/l
Nitrogen, Nitrate	0.10	mg/l
Nitrogen, Nitrite		mg/l
Oil & Grease	1.6	mg/l
pH	7.00	Units
Phosphorus, Ortho	0.07	mg/l
Phosphorus, Total	0.07	mg/l
Solids, Total Dissolved	1923	mg/l
Solids, Total Suspended	50.0	mg/l
Sulfate	740	mg/l
Sulfide		mg/l
Turbidity		NTU
TKN	0.18	mg/l
Total Cations	34.82	meq/l
Total Anions	34.78	meq/l

Parameter	Result	Units
Aluminum		mg/l
Arsenic	<0.001	mg/l
Barium	<0.1	mg/l
Beryllium		mg/l
Boron	1.06	mg/l
Cadmium	<0.005	mg/l
Calcium	214	mg/l
Chromium	<0.05	mg/l
Copper	0.02	mg/l
Iron	0.06	mg/l
Lead	<0.05	mg/l
Magnesium	237	mg/l
Manganese	0.01	mg/l
Mercury	<0.2	ug/l
Nickel	<0.04	mg/l
Potassium	16.1	mg/l
Selenium	<0.005	mg/l
Silica		mg/l
Sodium	97	mg/l
Vanadium		mg/l
Zinc	0.010	mg/l
Iron (Diss.)	<0.05	mg/l
Molybdenum	<0.02	mg/l
Silver	<0.01	mg/l

Analyst: [signature]

Respectfully submitted [signature]

Certified Environmental Laboratory

ANDALEX
RESOURCES, INC.
Tower Division

MEMORANDUM

TO: DOGM, General Inspection, File

FROM: Michael W. Glasson

SUBJECT: 1986 3rd Quarter Water Monitoring

WATER MONITORING 3RD QUARTER, 1986

7-1	No Flow
8-1	No Flow
S18-1	No Flow
18-2	No Flow
18-3	No Flow
18-4	No Flow
S25-1	No Flow
25-2	No Flow
Well #1	Not Sampled

ANDALEX
RESOURCES, INC.
Tower Division

M E M O R A N D U M

TO: DOGM, General Inspection, File

FROM: Michael W. Glasson

SUBJECT: 1986 2nd Quarter Water Monitoring

WATER MONITORING 2ND QUARTER, 1986

7-1	No Flow
8-1	No Flow
S18-1	No Flow
18-2	No Flow
18-3	No Flow
18-4	No Flow
S25-1	No Flow
25-2	No Flow
Well #1	Analysis Attached

CERTIFICATE OF ANALYSIS

STANDARD LABORATORIES, INC.
P.O. Box 1140, Huntington, Utah 84528 801-653-2314

Lab. No. 3287
Date Rec'd 6-30-86
Date Sampled ?
Time Sampled

Client: ANDALEX RESOURCES
P.O. BOX 902
PRICE, UTAH 84501

Sample ID: WELL #1
3rd 1/4

Parameter	Result	Units	Parameter	Result	Units
Acidity		mg/l $CaCO_3$	Aluminum		mg/l
Alkalinity, Total		mg/l $CaCO_3$	Arsenic		mg/l
Alkalinity, Bicarbonate		mg/l $CaCO_3$	Barium		mg/l
Alkalinity, Carbonate		mg/l $CaCO_3$	Beryllium		mg/l
Chloride		mg/l	Boron		mg/l
Coliform, Fecal		MPN/100 ml	Cadmium		mg/l
Coliform, Total		MPN/100 ml	Calcium		mg/l
Conductivity		umhos/cm	Chromium		mg/l
Fluoride		mg/l	Copper		mg/l
Hardness, Total		mg/l $CaCO_3$	Iron	0.22	mg/l
Nitrogen, Ammonia		mg/l	Lead		mg/l
Nitrogen, Nitrate		mg/l	Magnesium		mg/l
Nitrogen, Nitrite		mg/l	Manganese		mg/l
Oil & Grease		mg/l	Mercury		ug/l
pH		Units	Nickel		mg/l
Phosphorus, Ortho		mg/l	Potassium		mg/l
Phosphorus, Total		mg/l	Selenium		mg/l
Solids, Total Dissolved		mg/l	Silica		mg/l
Solids, Total Suspended		mg/l	Sodium		mg/l
Sulfate		mg/l	Vanadium		mg/l
Sulfide		mg/l	Zinc		mg/l
Turbidity		NTU			

Respectfully submitted David Yancey

Certified Environmental Laboratory

ANDALEX
RESOURCES, INC.
Tower Division

MEMORANDUM

TO: DOGM, General Inspection, File

FROM: Michael W. Glasson

SUBJECT: 1986 1st Quarter Water Monitoring

WATER MONITORING 1ST QUARTER, 1986

7-1	No Flow
8-1	No Flow
S18-1	Analysis Attached
18-2	No Flow
18-3	No Flow
18-4	No Flow
S25-1	No Flow
25-2	No Flow
Well #1	Analysis Attached

CERTIFICATE OF ANALYSIS

STANDARD LABORATORIES, INC.
Box 1140, Huntington, Utah 84528 801-653-2314

Client: TOWER RESOURCES
P.O. BOX 902
PRICE, UT 84501

Sample ID: S 18-1*

Lab. No. 8061
Date Rec'd 5-14-86
Date Sampled 3-13-86
Time Sampled

Acidity		mg/l $CaCO_3$
Alkalinity, Total		mg/l $CaCO_3$
Alkalinity, Bicarbonate		mg/l $CaCO_3$
Alkalinity, Carbonate		mg/l $CaCO_3$
Chloride		mg/l
Coliform, Fecal		MPN/100 ml
Coliform, Total		MPN/100 ml
Conductivity		umhos/cm
Fluoride		mg/l
Hardness, Total		mg/l $CaCO_3$
Nitrogen, Ammonia		mg/l
Nitrogen, Nitrate		mg/l
Nitrogen, Nitrite		mg/l
Oil & Grease	< 0.5	mg/l
pH		Units
Phosphorus, Ortho		mg/l
Phosphorus, Total		mg/l
Solids, Total Dissolved		mg/l
Solids, Total Suspended		mg/l
Sulfate		mg/l
Sulfide		mg/l
Turbidity		NTU

Aluminum		mg/l
Arsenic	< 0.001	mg/l
Barium	< 0.1	mg/l
Beryllium		mg/l
Boron	0.06	mg/l
Cadmium	< 0.005	mg/l
Calcium		mg/l
Chromium	< 0.05	mg/l
Copper	< 0.02	mg/l
Iron	0.06	mg/l
Lead		mg/l
Magnesium		mg/l
Manganese	0.02	mg/l
Mercury	< 0.2	ug/l
Nickel		mg/l
Potassium		mg/l
Selenium	< 0.005	mg/l
Silica		mg/l
Sodium		mg/l
Vanadium		mg/l
Zinc	< 0.005	mg/l
Iron (Diss.)	< 0.05	mg/l

*NO "PLAIN" BOTTLE RECEIVED

Analyst: [signature]

Respectfully submitted [signature]

Certified Environmental Laboratory

CERTIFICATE OF ANALYSIS

STANDARD LABORATORIES, INC.
Box 1140, Huntington, Utah 84528 801-653-2314

Lab. No. 8060
Date Rec'd 5-14-86
Date Sampled 3-13-86
Time Sampled

Client: TOWER RESOURCES
P.O. BOX 902
PRICE, UT 84501

Sample ID: WELL #1*

Acidity		mg/l $CaCO_3$
Alkalinity, Total		mg/l $CaCO_3$
Alkalinity, Bicarbonate		mg/l $CaCO_3$
Alkalinity, Carbonate		mg/l $CaCO_3$
Chloride		mg/l
Coliform, Fecal		MPN/100 ml
Coliform, Total		MPN/100 ml
Conductivity		umhos/cm
Fluoride		mg/l
Hardness, Total		mg/l $CaCO_3$
Nitrogen, Ammonia		mg/l
Nitrogen, Nitrate		mg/l
Nitrogen, Nitrite		mg/l
Oil & Grease	< 0.5	mg/l
pH		Units
Phosphorus, Ortho		mg/l
Phosphorus, Total		mg/l
Solids, Total Dissolved		mg/l
Solids, Total Suspended		mg/l
Sulfate		mg/l
Sulfide		mg/l
Turbidity		NTU

Aluminum		mg/l
Arsenic	< 0.001	mg/l
Barium	< 0.1	mg/l
Beryllium		mg/l
Boron	0.05	mg/l
Cadmium	< 0.005	mg/l
Calcium		mg/l
Chromium	< 0.05	mg/l
Copper	< 0.02	mg/l
Iron	14.24	mg/l
Lead		mg/l
Magnesium		mg/l
Manganese	0.27	mg/l
Mercury	< 0.2	ug/l
Nickel		mg/l
Potassium		mg/l
Selenium	< 0.005	mg/l
Silica		mg/l
Sodium		mg/l
Vanadium		mg/l
Zinc	0.100	mg/l
Iron (Diss.)	13.98	mg/l

*No "Plain" bottle received

Analyst: [signature]

Respectfully submitted [signature]

Certified Environmental Laboratory

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Received
SEP 25 1985
Tower Resources Inc.

DATE: 09/24/85
CERTIFICATE OF ANALYSIS

TOWER RESOURCES
P.O. BOX 902
PRICE, UT
84501

85-008675

SAMPLE: WATER SAMPLES RECEIVED 8-16-85 FOR ANALYSIS.

	S18-3 8-2-85	S25-1 7-17-85	PD-1 7-25-85	PD 7-25-85
Acidity as CaCO3 mg/l SM402	14.80	48.40	23.00	59.90
Alkalinity,CaCO3 mg/l SM403	<1.0	506	238	456
Ammonia, NH3-N mg/l SM417F	.02	.03	<.01	<.01
Arsenic, As (Tot) mg/l SM304	<.001	<.001	<.001	<.001
Barium, Ba (Tot) mg/l SM303A	.04	.22	.01	.01
Bicarbonate,HCO3 mg/l SM403	461.20	617.30	290.40	556.30
Boron as B Total mg/l SM404A	.277	.591	.894	1.890
Cadmium,Cd (Tot) mg/l SM304	<.001	<.001	<.001	<.001
Calcium, Ca mg/l SM303A	91.20	168.80	122.40	264.00
Carbonate as CO3 mg/l SM403	<.01	<.01	<.01	<.01
Chloride, Cl mg/l SM407A	39.7	37.8	96.7	216
Chromium,Cr (Tot) mg/l SM303A	.003	.001	.003	.004
Conductivity umhos/cm SM205	1,950	2,180	3,350	7,400

Ford Chemical LABORATORY, INC.

Bacteriological and Chemical Analysis

40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

CERTIFICATE OF ANALYSIS

85-008675

	S18-3 8-2-85	S25-1 7-17-85	PD-1 7-25-85	PD 7-25-85
Copper, Cu (Tot) mg/l SM303A	<.02	<.02	<.02	<.02
Fluoride, F mg/l SM413B	<.01	.62	.61	1.02
Iron, Fe (Dis) mg/l SM303A	<.02	<.02	.03	<.02
Iron, Fe (Tot) mg/l SM303A	.25	.03	.14	.21
Lead, Pb (Tot) mg/l SM303A	<.001	<.001	<.001	<.001
Magnesium, Mg mg/l SM303A	169.90	183.40	262.60	566.40
Manganese,Mn (Tot) mgl SM303A	<.03	<.03	.33	.76
Mercury, Hg mg/l SM320A	<.0002	<.0002	<.0002	<.0002
Molybdenum Mo Tot.mg/lSM303C	<.007	<.007	<.007	<.007
Nitrate, NO3-N mg/l SM418C	.60	2.31	3.96	.10
Oil and Grease mg/l SM503C	<.1	<.1	<.1	.6
Phosphate PO4-P Ortho mg/l	<.01	<.01	<.01	<.01
Phosphate PO4-P T.mg/l SM424G	.05	<.01	.04	<.01
Potassium, K mg/l SM303A	9.40	31.10	44.70	60.00
Selenium, Se Tot. mg/l SM304	<.001	<.001	<.001	<.001
Silver, Ag (Tot) mg/l SM303A	<.001	<.001	<.001	<.001
Sodium, Na mg/l SM303A	84.00	82.00	177.00	465.00

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

CERTIFICATE OF ANALYSIS

85-008675

	S18-3 8-2-85	S25-1 7-17-85	PD-1 7-25-85	PD 7-25-85
Sulfate, SO4 mg/l SM426D	596	602	1,310	2,930
Suspended Solids mg/l SM 209D	25.0	9.0	12.0	14.0
Total Dis. Solids mg/l SM209B	1,250	1,440	2,180	4,795
Total Kjeldahl Nit.ppm SM420A	.10	.06	<.01	.05
Zinc, Zn (Tot) mg/l SM303A	.054	<.003	.106	.471
pH Units SM423	8.00	7.80	7.60	7.50

FORD CHEMICAL LABORATORY, INC.

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis

40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

DATE: 09/24/85
CERTIFICATE OF ANALYSIS

85-008675-01

FORD CHEMICAL LABORATORIES

BALANCE SHEET FOR SAMPLE: (1) S18-3 8-2-85

C A T I O N S	mg/l	meq/l
Calcium, Ca mg/l SM303A	91.200	4.551
Magnesium, Mg mg/l SM303A	169.900	13.974
Iron, Fe (Dis) mg/l SM303A	.000	.000
Sodium, Na mg/l SM303A	84.000	3.654
Potassium, K mg/l SM303A	9.400	.240

A N I O N S	mg/l	meq/l
Carbonate as CO3 mg/l SM403	.000	.000
Bicarbonate,HCO3 mg/l SM403	461.200	7.564
Sulfate, SO4 mg/l SM426D	596.000	12.409
Chloride, Cl mg/l SM407A	39.700	1.120
Nitrate, NO3-N mg/l SM418C	.600	.010
Acidity as CaCO3 mg/l SM402	14.800	1.231

B A L A N C E   I N F O R M A T I O N

CATIONS:	22.419
ANIONS:	22.334
TOTAL:	44.753
DIFFERENCE:	.085
SIGMA:	.001

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

DATE: 09/24/85
CERTIFICATE OF ANALYSIS

85-008675-02

FORD CHEMICAL LABORATORIES

BALANCE SHEET FOR SAMPLE: (2) S25-1 7-17-85

C A T I O N S	mg/l	meq/l
Calcium, Ca mg/l SM303A	168.800	8.423
Magnesium, Mg mg/l SM303A	183.400	15.085
Iron, Fe (Dis) mg/l SM303A	.000	.000
Sodium, Na mg/l SM303A	82.000	3.567
Potassium, K mg/l SM303A	31.100	.795

A N I O N S	mg/l	meq/l
Carbonate as CO3 mg/l SM403	.000	.000
Bicarbonate,HCO3 mg/l SM403	617.300	10.124
Sulfate, SO4 mg/l SM426D	602.000	12.534
Chloride, Cl mg/l SM407A	37.800	1.066
Nitrate, NO3-N mg/l SM418C	2.310	.038
Acidity as CaCO3 mg/l SM402	48.400	4.027

B A L A N C E I N F O R M A T I O N

CATIONS:	27.870
ANIONS:	27.789
TOTAL:	55.659
DIFFERENCE:	.081
SIGMA:	.001

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

DATE: 09/24/85

CERTIFICATE OF ANALYSIS

85-008675-03

FORD CHEMICAL LABORATORIES

BALANCE SHEET FOR SAMPLE: (3) PD-1 7-25-85

C A T I O N S	mg/l	meq/l
Calcium, Ca mg/l SM303A	122.400	6.108
Magnesium, Mg mg/l SM303A	262.600	21.599
Iron, Fe (Dis) mg/l SM303A	.030	.001
Sodium, Na mg/l SM303A	177.000	7.700
Potassium, K mg/l SM303A	44.700	1.143

A N I O N S	mg/l	meq/l
Carbonate as CO3 mg/l SM403	.000	.000
Bicarbonate,HCO3 mg/l SM403	290.400	4.763
Sulfate, SO4 mg/l SM426D	1310.000	27.274
Chloride, Cl mg/l SM407A	96.700	2.728
Nitrate, NO3-N mg/l SM418C	3.960	.065
Acidity as CaCO3 mg/l SM402	23.000	1.914

B A L A N C E   I N F O R M A T I O N

CATIONS:	36.551
ANIONS:	36.744
TOTAL:	73.295
DIFFERENCE:	.193
SIGMA:	.002

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

DATE: 09/24/85
CERTIFICATE OF ANALYSIS

85-008675-04

FORD CHEMICAL LABORATORIES

BALANCE SHEET FOR SAMPLE: (4) PD 7-25-85

C A T I O N S	mg/l	meq/l
Calcium, Ca mg/l SM303A	264.000	13.174
Magnesium, Mg mg/l SM303A	566.400	46.586
Iron, Fe (Dis) mg/l SM303A	.000	.000
Sodium, Na mg/l SM303A	465.000	20.228
Potassium, K mg/l SM303A	60.000	1.534

A N I O N S	mg/l	meq/l
Carbonate as CO3 mg/1 SM403	.000	.000
Bicarbonate,HCO3 mg/l SM403	556.300	9.123
Sulfate, SO4 mg/l SM426D	2930.000	61.003
Chloride, Cl mg/l SM407A	216.000	6.093
Nitrate, NO3-N mg/l SM418C	.100	.002
Acidity as CaCO3 mg/l SM402	59.900	4.984

B A L A N C E   I N F O R M A T I O N

CATIONS:	81.522
ANIONS:	81.205
TOTAL:	162.727
DIFFERENCE:	.317
SIGMA:	.001

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

JUN 1 1985
Tower Resources Inc.

DATE: 05/29/85

TOWER RESOURCES
P.O. BOX 902
PRICE, UT
84501

CERTIFICATE OF ANALYSIS
85-006685

SAMPLE: SPRING WATER SAMPLE S-25 COLLECTED 4-8-85 RECEIVED 4-17-85 FOR ANALYSIS.

	RESULTS
Acidity as CaCO3 mg/l SM402	74.00
Alkalinity,CaCO3 mg/l SM403	408
Ammonia, NH3-N mg/l SM417C	.05
Arsenic, As (Tot) mg/l SM304	<.001
Barium, Ba (Tot) mg/l SM303A	<.05
Bicarbonate,HCO3 mg/l SM403	498.00
Boron as B Total mg/l SM404A	.530
Cadmium,Cd (Tot) mg/l SM304	<.001
Calcium, Ca mg/l SM303A	106.77
Carbonate as CO3 mg/l SM403	<.01
Chloride, Cl mg/l SM407A	38.0
Chromium,Cr (Tot) mg/l SM303A	<.001
Conductivity umhos/cm SM205	1,590

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

85-006685

CERTIFICATE OF ANALYSIS

	RESULTS
Copper, Cu (Tot) mg/l SM303A	<.01
Fluoride, F mg/l SM413B	.36
Iron, Fe (Dis) mg/l SM303A	<.01
Iron, Fe (Tot) mg/l SM303A	.06
Lead, Pb (Tot) mg/l SM303A	<.001
Magnesium, Mg mg/l SM303A	107.58
Manganese,Mn (Tot) mgl SM303A	<.01
Mercury, Hg mg/l SM320A	.0005
Molybdenum Mo Tot.mg/lSM303C	.002
Nitrate, NO3-N mg/l SM418C	2.50
Oil and Grease mg/l SM503C	<.1
Phosphate PO4-P Ortho mg/l	.06
Phosphate PO4-P T.mg/l SM424G	.01
Potassium, K mg/l SM303A	12.20
Selenium, Se Tot. mg/l SM304	<.001
Silver, Ag (Tot) mg/l SM303A	<.001
Sodium, Na mg/l SM303A	47.25

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis

40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

85-006685

CERTIFICATE OF ANALYSIS

	RESULTS
Sulfate, SO4 mg/l SM426D	48
Suspended Solids mg/l SM 209D	17.0
Total Dis. Solids mg/l SM209B	1,040
Total Kjeldahl Nit.ppm SM420A	.18
Zinc, Zn (Tot) mg/l SM303A	<.005
pH Units SM423	7.20

FORD CHEMICAL LABORATORY, INC.

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

DATE: 05/29/85

85-006685-01
CERTIFICATE OF ANALYSIS

FORD CHEMICAL LABORATORIES

BALANCE SHEET FOR SAMPLE: (1) RESULTS

C A T I O N S	mg/l	meq/l
Calcium, Ca mg/l SM303A	106.770	5.328
Magnesium, Mg mg/l SM303A	107.580	8.848
Iron, Fe (Dis) mg/l SM303A	.000	.000
Sodium, Na mg/l SM303A	47.250	2.055
Potassium, K mg/l SM303A	12.200	.312

A N I O N S	mg/l	meq/l
Carbonate as CO3 mg/l SM403	.000	.000
Bicarbonate,HCO3 mg/l SM403	498.000	8.167
Sulfate, SO4 mg/l SM426D	48.000	.999
Chloride, Cl mg/l SM407A	38.000	1.072
Nitrate, NO3-N mg/l SM418C	2.500	.041
Acidity as CaCO3 mg/l SM402	74.000	6.157

B A L A N C E   I N F O R M A T I O N

CATIONS:	16.543
ANIONS:	16.436
TOTAL:	32.979
DIFFERENCE:	.107
SIGMA:	.003

Ford Chemical LABORATORY, INC.

Bacteriological and Chemical Analysis

40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

DATE: 08/26/85

CERTIFICATE OF ANALYSIS

TOWER RESOURCES
P.O. BOX 902
PRICE, UT
84501

85-008676

SAMPLE: WATER SAMPLE PD-2 COLLECTED 8-9-85 RECEIVED 8-16-85 FOR ANALYSIS.

Received
AUG 28 [illegible]
Tower Resources Inc.

	PD-2
Cyanide Cn tot.mg/l EPA 425.1	.002
Phenol ppm SM510B	<.001

FORD CHEMICAL LABORATORY, INC.

Ford Chemical LABORATORY, INC.

Bacteriological and Chemical Analysis

40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

NOV 11 1985

DATE: 11/07/85

CERTIFICATE OF ANALYSIS

*TOWER RESOURCES INC
ATTN: ALLEN EMMEL
P.O. BOX 902
PRICE, UT 84501

85-009910

SAMPLE: WATER SAMPLES RECEIVED 10-25-85 FOR ANALYSIS.

	WELL #1 10-17-85	S25-1 10-16-85
Acidity as CaCO3 mg/l SM402Y	15.60	33.90
Alkalinity,CaCO3 mg/l SM403	298	540
Ammonia, NH3-N mg/l SM417F	.65	<.01
Arsenic, As (Tot) mg/l SM304	<.001	<.001
Barium, Ba (Tot) mg/l SM303A	.03	.05
Bicarbonate,HCO3 mg/l SM403	363.60	658.80
Boron as B Total mg/l SM404A	.370	.400
Cadmium,Cd (Tot) mg/l SM304	<.001	<.001
Calcium, Ca mg/l SM303A	41.60	181.60
Carbonate as CO3 mg/l SM403	<.01	<.01
Chloride, Cl mg/l SM407A	110	31.1
Chromium,Cr (Tot) mg/l SM303A	.023	<.001
Conductivity umhos/cm SM205	1,666	2,000

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

CERTIFICATE OF ANALYSIS
85-009910

	WELL #1 10-17-85	S25-1 10-16-85
Copper, Cu (Tot) mg/l SM303A	.05	.02
Fluoride, F mg/l SM413B	.20	.55
Iron, Fe (Dis) mg/l SM303A	.04	<.01
Iron, Fe (Tot) mg/l SM303A	111.50	.09
Lead, Pb (Tot) mg/l SM303A	.017	<.001
Magnesium, Mg mg/l SM303A	197.30	190.00
Manganese,Mn (Tot) mgl SM303A	1.04	.02
Mercury, Hg mg/l SM320A	<.0002	<.0002
Molybdenum Mo Tot.mg/lSM303C	.040	<.010
Nitrate, NO3-N mg/l SM418C	.03	1.70
Oil and Grease mg/l SM503C	1.6	1.8
Phosphate PO4-P Ortho mg/l	<.01	<.01
Phosphate PO4-P T.mg/l SM424G	<.01	<.01
Potassium, K mg/l SM303A	14.02	10.66
Selenium, Se Tot. mg/l SM304	<.001	<.001
Silver, Ag (Tot) mg/l SM303A	<.001	<.001
Sodium, Na mg/l SM303A	76.00	45.60

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

CERTIFICATE OF ANALYSIS
85-009910

	WELL #1 10-17-85	S25-1 10-16-85
Sulfate, SO4 mg/l SM426D	656	733
Total Dis. Solids mg/l SM209B	1,278	1,590
Total Kjeldahl Nit.ppm SM420A	.85	<.01
Zinc, Zn (Tot) mg/l SM303A	4.720	.024
[illegible] Units SM423	8.05	7.75

FORD CHEMICAL LABORATORY, INC.

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

DATE: 11/07/85

CERTIFICATE OF ANALYSIS

85-009910-01

FORD CHEMICAL LABORATORIES

BALANCE SHEET FOR SAMPLE: (1) WELL #1 10-17-85

C A T I O N S	mg/l	meq/l
Acidity as CaCO3 mg/l SM402Y	15.600	.156
Calcium, Ca mg/l SM303A	41.600	2.076
Magnesium, Mg mg/l SM303A	197.300	16.228
Iron, Fe (Dis) mg/l SM303A	.040	.001
Sodium, Na mg/l SM303A	76.000	3.306
Potassium, K mg/l SM303A	14.020	.358

A N I O N S	mg/l	meq/l
Carbonate as CO3 mg/l SM403	.000	.000
Bicarbonate,HCO3 mg/l SM403	363.600	5.963
Sulfate, SO4 mg/l SM426D	656.000	13.658
Chloride, Cl mg/l SM407A	110.000	3.103
Nitrate, NO3-N mg/l SM418C	.030	.000

B A L A N C E   I N F O R M A T I O N

CATIONS:	22.125
ANIONS:	22.724
TOTAL:	44.849
DIFFERENCE:	.599
SIGMA:	.013

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

DATE: 11/07/85

CERTIFICATE OF ANALYSIS

85-009910-02

FORD CHEMICAL LABORATORIES

BALANCE SHEET FOR SAMPLE: (2) S25-1 10-16-85

C A T I O N S	mg/l	meq/l
Acidity as CaCO3 mg/l SM402Y	33.900	.339
Calcium, Ca mg/l SM303A	181.600	9.062
Magnesium, Mg mg/l SM303A	190.000	15.628
Iron, Fe (Dis) mg/l SM303A	.000	.000
Sodium, Na mg/l SM303A	45.600	1.984
Potassium, K mg/l SM303A	10.660	.273

A N I O N S	mg/l	meq/l
Carbonate as CO3 mg/l SM403	.000	.000
Bicarbonate,HCO3 mg/l SM403	658.800	10.804
Sulfate, SO4 mg/l SM426D	733.000	15.261
Chloride, Cl mg/l SM407A	31.100	.877
Nitrate, NO3-N mg/l SM418C	1.700	.028

B A L A N C E   I N F O R M A T I O N

CATIONS:	27.286
ANIONS:	26.970
TOTAL:	54.256
DIFFERENCE:	.316
SIGMA:	.005

Ford Chemical LABORATORY, INC.

Bacteriological and Chemical Analysis

40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

FEB [illegible] 1985

DATE: 02/13/85

CERTIFICATE OF ANALYSIS

TOWER RESOURCES
P.O. BOX 902
PRICE, UT
84501

85-005494

SAMPLE: WELL #1 WATER SAMPLE COLLECTED 1-23-85 RECEIVED 1-30-85 FOR ANALYSIS.

RESULTS

Acidity as CaCO3 mg/l SM402	70.40
Alkalinity,CaCO3 mg/l SM403	499
Ammonia, NH3-N mg/l SM417C	1.50
Arsenic, As (Tot) mg/l SM304	<.001
Barium, Ba (Tot) mg/l SM303A	.05
Bicarbonate,HCO3 mg/l SM403	609.00
Boron as B Total mg/l	.035
Cadmium,Cd (Tot) mg/l SM304	<.001
Calcium, Ca mg/l SM303A	132.00
Carbonate as CO3 mg/1 SM403	<.01
Chloride, Cl mg/l SM407A	146
Chromium,Cr (Tot) mg/l SM303A	.008
Conductivity umhos/cm SM205	3,200

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

CERTIFICATE OF ANALYSIS
85-005494

RESULTS

Copper, Cu (Tot) mg/l SM303A	.020
Fluoride, F mg/l SM413B	.26
Iron, Fe (Dis) mg/l SM303A	6.45
Iron, Fe (Tot) mg/l SM303A	45.50
Lead, Pb (Tot) mg/l SM303A	.104
Magnesium, Mg mg/l SM303A	251.00
Manganese,Mn (Tot) mgl SM303A	.41
Mercury, Hg mg/l SM320A	<.0002
Molybdenum as Mo (Tot) mg/l	<.001
Nitrate, NO3-N mg/l SM418C	<.01
Oil and Grease mg/l SM503C	<.1
Phosphate PO4-P Ortho mg/l	.02
Phosphate PO4-P Tot mg/l	<.02
Potassium, K mg/l SM303A	15.10
Selenium, Se Tot. mg/l SM304	<.001
Silver, Ag (Tot) mg/l SM303A	<.0010
Sodium, Na mg/l SM303A	190.00

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

CERTIFICATE OF ANALYSIS
85-005494

RESULTS

Sulfate, SO4 mg/l SM426D	800
Suspended Solids mg/l SM 209D	7.0
Total Kjeldahl Nitrogen mg/l	2.65
Total Solids mg/l	2,116
Zinc, Zn (Tot) mg/l SM303A	4.980
pH Units SM423	6.90

FORD CHEMICAL LABORATORY, INC.

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

DATE: 02/13/85

CERTIFICATE OF ANALYSIS

85-005494-01

FORD CHEMICAL LABORATORIES

BALANCE SHEET FOR SAMPLE: (1) RESULTS

C A T I O N S	mg/l	meq/l
Calcium, Ca mg/l SM303A	132.000	6.587
Magnesium, Mg mg/l SM303A	251.000	20.645
Iron, Fe (Dis) mg/l SM303A	6.450	.231
Sodium, Na mg/l SM303A	190.000	8.265
Potassium, K mg/l SM303A	15.100	.386

A N I O N S	mg/l	meq/l
Carbonate as CO3 mg/l SM403	.000	.000
Bicarbonate,HCO3 mg/l SM403	609.000	9.988
Sulfate, SO4 mg/l SM426D	800.000	16.656
Chloride, Cl mg/l SM407A	146.000	4.119
Nitrate, NO3-N mg/l SM418C	.000	.000
Acidity as CaCO3 mg/l SM402	70.400	5.857

B A L A N C E   I N F O R M A T I O N

CATIONS:	36.114
ANIONS:	36.620
TOTAL:	72.734
DIFFERENCE:	.506
SIGMA:	.006

Ford Chemical LABORATORY, INC.

Bacteriological and Chemical Analysis

40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

DATE: 06/25/85

CERTIFICATE OF ANALYSIS

TOWER RESOURCES
P.O. BOX 902
PRICE, UT
84501

85-007226

SAMPLE: WATER SAMPLES COLLECTED 4-29-85 RECEIVED 5-16-85 FOR ANALYSIS.

	7-1	18-4
Acidity as $CaCO_3$ mg/l SM402	24.00	20.00
Alkalinity, $CaCO_3$ mg/l SM403	299	314
Ammonia, NH_3-N mg/l SM417F	<.01	.05
Arsenic, As (Tot) mg/l SM304	<.001	<.001
Barium, Ba (Tot) mg/l SM303A	.08	.08
Bicarbonate, HCO_3 mg/l SM403	365.00	383.00
Boron as B Total mg/l SM404A	.043	.039
Cadmium, Cd (Tot) mg/l SM304	<.001	<.001
Calcium, Ca mg/l SM303A	75.10	74.40
Carbonate as CO_3 mg/l SM403	<.01	<.01
Chloride, Cl mg/l SM407A	9.3	9.6
Chromium, Cr (Tot) mg/l SM303A	<.001	<.001
Conductivity umhos/cm SM205	750	620

Ford Chemical LABORATORY, INC.

Bacteriological and Chemical Analysis

40 WEST LOUISE AVENUE

SALT LAKE CITY, UTAH 84115

PHONE 466-8761

CERTIFICATE OF ANALYSIS
85-007226

	7-1	18-4
Copper, Cu (Tot) mg/l SM303A	<.01	<.01
Fluoride, F mg/l SM413B	.26	.26
Iron, Fe (Dis) mg/l SM303A	.09	.09
Iron, Fe (Tot) mg/l SM303A	.09	.09
Lead, Pb (Tot) mg/l SM303A	.002	<.001
Magnesium, Mg mg/l SM303A	64.70	64.10
Manganese,Mn (Tot) mgl SM303A	<.01	<.01
Mercury, Hg mg/l SM320A	<.0002	<.0002
Molybdenum Mo Tot.mg/lSM303C	.004	.004
Nitrate, NO3-N mg/l SM418C	.08	.03
Oil and Grease mg/l SM503C	1.8	.6
Phosphate PO4-P Ortho mg/l	<.01	.04
Phosphate PO4-P T.mg/l SM424G	.01	.03
Potassium, K mg/l SM303A	3.40	3.60
Selenium, Se Tot. mg/l SM304	<.001	<.001
Silver, Ag (Tot) mg/l SM303A	<.0010	<.0010
Sodium, Na mg/l SM303A	33.00	32.00

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

CERTIFICATE OF ANALYSIS
85-007226

	7-1	18-4
Sulfate, SO4 mg/l SM426D	122	116
Suspended Solids mg/l SM 209D	7.0	6.0
Total Dis. Solids mg/l SM209B	490	410
Total Kjeldahl Nit.ppm SM420A	.50	.15
Zinc, Zn (Tot) mg/l SM303A	.017	.013
pH Units SM423	7.90	8.00

FORD CHEMICAL LABORATORY, INC.

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

DATE: 06/25/85

CERTIFICATE OF ANALYSIS

85-007226-01

FORD CHEMICAL LABORATORIES

BALANCE SHEET FOR SAMPLE: (1) 7-1

C A T I O N S	mg/l	meq/l
Calcium, Ca mg/l SM303A	75.100	3.747
Magnesium, Mg mg/l SM303A	64.700	5.322
Iron, Fe (Dis) mg/l SM303A	.090	.003
Sodium, Na mg/l SM303A	33.000	1.436
Potassium, K mg/l SM303A	3.400	.087

A N I O N S	mg/l	meq/l
Carbonate as CO3 mg/l SM403	.000	.000
Bicarbonate,HCO3 mg/l SM403	365.000	5.986
Sulfate, SO4 mg/l SM426D	122.000	2.540
Chloride, Cl mg/l SM407A	9.300	.262
Nitrate, NO3-N mg/l SM418C	.080	.001
Acidity as CaCO3 mg/l SM402	24.000	1.997

B A L A N C E   I N F O R M A T I O N

CATIONS:	10.595
ANIONS:	10.786
TOTAL:	21.381
DIFFERENCE:	.191
SIGMA:	.008

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

DATE: 06/25/85

CERTIFICATE OF ANALYSIS

85-007226-02

FORD CHEMICAL LABORATORIES

BALANCE SHEET FOR SAMPLE: (2) 18-4

C A T I O N S	mg/l	meq/l
Calcium, Ca mg/l SM303A	74.400	3.713
Magnesium, Mg mg/l SM303A	64.100	5.272
Iron, Fe (Dis) mg/l SM303A	.090	.003
Sodium, Na mg/l SM303A	32.000	1.392
Potassium, K mg/l SM303A	3.600	.092

A N I O N S	mg/l	meq/l
Carbonate as CO3 mg/l SM403	.000	.000
Bicarbonate, HCO3 mg/l SM403	383.000	6.281
Sulfate, SO4 mg/l SM426D	116.000	2.415
Chloride, Cl mg/l SM407A	9.600	.271
Nitrate, NO3-N mg/l SM418C	.030	.000
Acidity as CaCO3 mg/l SM402	20.000	1.664

B A L A N C E   I N F O R M A T I O N

CATIONS:	10.472
ANIONS:	10.631
TOTAL:	21.103
DIFFERENCE:	.159
SIGMA:	.007

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

Received
OCT 10 1985
T[illegible] Resources Inc.

DATE: 10/09/85

CERTIFICATE OF ANALYSIS

TOWER RESOURCES
P.O. BOX 902
PRICE, UT
84501

85-009182

SAMPLE: WATER FROM CENTENNIAL PROJECT RECEIVED 9-19-85 FOR ANALYSIS.

	WELL #1
Acidity as CaCO3 mg/l SM402	14.20
Alkalinity,CaCO3 mg/l SM403	278
Ammonia, NH3-N mg/l SM417F	.44
Arsenic, As (Tot) mg/l SM304	<.001
Barium, Ba (Tot) mg/l SM303A	.01
Bicarbonate,HCO3 mg/l SM403	339.00
Boron as B Total mg/l SM404A	.310
Cadmium,Cd (Tot) mg/l SM304	<.001
Calcium, Ca mg/l SM303A	25.60
Carbonate as CO3 mg/l SM403	<.01
Chloride, Cl mg/l SM407A	117
Chromium,Cr (Tot) mg/l SM303A	.008
Conductivity umhos/cm SM205	1,750

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

CERTIFICATE OF ANALYSIS
85-009182

WELL #1

Copper, Cu (Tot) mg/l SM303A	.02
Fluoride, F mg/l SM413B	.21
Iron, Fe (Dis) mg/l SM303A	<.01
Iron, Fe (Tot) mg/l SM303A	60.50
Lead, Pb (Tot) mg/l SM303A	.013
Magnesium, Mg mg/l SM303A	198.70
Manganese,Mn (Tot) mgl SM303A	.75
Mercury, Hg mg/l SM320A	<.0002
Molybdenum Mo Tot.mg/lSM303C	.030
Nitrate, NO3-N mg/l SM418C	.10
Oil and Grease mg/l SM503C	<.1
Phosphate PO4-P Ortho mg/l	<.01
Phosphate PO4-P T.mg/l SM424G	.03
Potassium, K mg/l SM303A	15.95
Selenium, Se Tot. mg/l SM304	<.001
Silver, Ag (Tot) mg/l SM303A	.001
Sodium, Na mg/l SM303A	78.00

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

CERTIFICATE OF ANALYSIS
85-009182

WELL #1

Sulfate, SO4 mg/l SM426D	540
Suspended Solids mg/l SM 209D	142
Total Dis. Solids mg/l SM209B	1,210
Total Kjeldahl Nit.ppm SM420A	.65
Zinc, Zn (Tot) mg/l SM303A	4.250
pH Units SM423	8.00

FORD CHEMICAL LABORATORY, INC.

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

DATE: 10/09/85

CERTIFICATE OF ANALYSIS

85-009182-01

FORD CHEMICAL LABORATORIES

BALANCE SHEET FOR SAMPLE: (1) WELL #1

C A T I O N S	mg/l	meq/l
Calcium, Ca mg/l SM303A	25.600	1.277
Magnesium, Mg mg/l SM303A	198.700	16.343
Iron, Fe (Dis) mg/l SM303A	.000	.000
Sodium, Na mg/l SM303A	78.000	3.393
Potassium, K mg/l SM303A	15.950	.408

A N I O N S	mg/l	meq/l
Carbonate as CO3 mg/l SM403	.000	.000
Bicarbonate,HCO3 mg/l SM403	339.000	5.560
Sulfate, SO4 mg/l SM426D	540.000	11.243
Chloride, Cl mg/l SM407A	117.000	3.301
Nitrate, NO3-N mg/l SM418C	.100	.002
Acidity as CaCO3 mg/l SM402	14.200	1.181

B A L A N C E   I N F O R M A T I O N

CATIONS:	21.421
ANIONS:	21.287
TOTAL:	42.708
DIFFERENCE:	.134
SIGMA:	.003

3.3-2 Detailed Analysis of Coal Seams and Surrounding Strata

3.3-2.1 Source of Data

Analysis was performed on rib samples and core samples obtained during the exploration activities described in section 3.2, re Geologic Description of the Mine Plan and Adjacent Areas, of this part and Chapter. Results of these analyses are listed according to seam in Appendix E.

Analysis was performed by: Commercial Testing and Engineering Company, 10775 East 51st Avenue, Denver, Colorado 80239, and other commercial testing laboratories.

3.3-2.2 Coal Seams

3.3-2.2-1 Pyritic, Marcasitic Content

3.3-2.2-2 Total Sulfur Content

See Appendix E.

3.3-2.2-3 Other Characteristics

See Appendix E.

3.3-2.3 Stratum Immediately Overlying each Coal Seam to be Mined

3.3-2.3-1 Lithology (See Figures IV-2 and IV-3)

Aberdeen Coal Seam (Castlegate "A") ------------ overlying this seam is interbedded sandstone, siltstone, and carbonaceous shales of the Aberdeen Member of the Blackhawk.

Gilson Coal Seam ------------ overlying this seam is interbedded sandstone, siltstone, and shale with coal riders of the Kenilworth Member of the Blackhawk.

Lower Sunnyside Seam ------------ overlying this seam is interbedded sandstone, siltstone, shale, and coal riders of the Sunnyside Member of the Blackhawk.

It should be noted however, that the immediate "roof" over each seam is a sandstone unit, over which is found the silts, shales, and various coal riders.

3.3-2.3-2 Pyritic Content (Laboratory Analysis)

Complete analysis of these strata has been included following this page.

3.3-2.3-3 Potential Alkalinity (Laboratory Analysis)

Complete analysis of these strata has been included following this page.

3.3-2.4 Stratum Immediately Underlying Each Coal Seam

3.3-2.4-1 Lithology (See Figure IV-2 and IV-3)

Aberdeen (Castlegate "A" Seam) ------------- underlying this seam is basal sandstone of littoral marine sandstone, the Aberdeen Sandstone of the Aberdeen Member.

Gilson Seam ------------- underlying this seam is interbedded sandstone, siltstone, shale, and coal riders of the Kenilworth Member.

Lower Sunnyside Seam ------------- underlying this seam is barrier beach sandstone, the Lower Sunnyside Sandstone of the Sunnyside Member.

It should be noted however, that the immediate "floor" below the seams is sandstone in the case of the Lower Sunnyside and Aberdeen; and beneath the Gilson Siltstone.

3.3-2.4-2 Pyritic Content (Laboratory Analysis)

Complete analysis of these strata has been included following this page.

3.3-2.4-3 Potential Alkalinity (Laboratory Analysis)

Complete analysis of these strata has been included following this page.

3.3-2.4-4 Clay Content (Laboratory Analysis)

Complete analysis of these strata has been included following this page.

II. LABORATORY ANALYSIS

LABORATORY ANALYSIS - LOWER SUNNYSIDE SEAM

ROOF

DETERMINATION (%)	DH-1 55'7"-60'7"	DH-5 407'-412'	DH-6 1793'10"-1798'10"	DH-6 1796'10"-1798'10"
pH (paste)	7.0	7.1	7.7	7.6
Electrical Conductivity @25°C (mmhos/cm)	2.2	3.2	1.2	1.1
Saturation Percentage	30	27	29	34
Calcium (meq/l)	14	19	1.1	1.1
Magnesium (meq/l)	12	23	1.1	0.62
Sodium (meq/l)	2.0	3.8	10	9.8
SAR	0.55	0.83	9.5	11
ESP	-0.44	-0.04	11	12
Calcium Carbonate Equiv.	14	18	20	15
Pyritic Sulfur	-	-	-	-
Particle Size Analysis	-	-	-	-
Very Fine Sand	-	-	-	-
Sand	67	68	75	78
Silt	22	17	12	11
Clay	11	15	13	11
Texture (USDA)	sl	sl	sl	sl

FLOOR

DETERMINATION (%)	DH-1 65'-70'	DH-5 418'2"-423'2"	DH-6 1802'9"-1809'9"
pH (paste)	3.8	7.4	3.6
Electrical Conductivity @25°C (mmhos/cm)	5.2	2.6	4.3
Saturation Percentage	32	30	34
Calcium (meq/l)	47	6.7	45
Magnesium (meq/l)	15	6.3	21
Sodium (meq/l)	0.68	17	1.3
SAR	0.12	6.7	0.23
ESP	-1.1	7.9	-0.93
Calcium Carbonate Equiv.	0.24	19	0.38
Pyritic Sulfur	0.28	-	0.29
Particle Size Analysis	-	-	-
Very Fine Sand	-	-	-
Sand	82	73	77
Silt	13	15	13
Clay	5	12	10
Texture (USDA)	ls	sl	sl

Analysis performed by Camp Dresser & McKee Inc.

Locations of drill holes DH-1, DH-5, and DH-6 are shown on Plates 26, 27 and 28.

LABORATORY ANALYSIS - GILSON SEAM

ROOF

DETERMINATION (%)	DH-1 260'3"-265'3"
pH (paste)	7.5
Electrical Conductivity @25°C (mmhos/cm)	2.4
Saturation Percentage	28
Calcium (meq/l)	4.3
Magnesium (meq/l)	2.2
Sodium (meq/l)	19
SAR	10
ESP	12
Calcium Carbonate Equiv.	8.3
Pyritic Sulfur	-
Particle Size Analysis	-
Very Fine Sand	-
Sand	61
Silt	28
Clay	11
Texture (USDA)	sl

FLOOR

DETERMINATION (%)	DH-1 272'4"-277'4"
pH (paste)	6.9
Electrical Conductivity @25°C (mmhos/cm)	1.0
Saturation Percentage	26
Calcium (meq/l)	2.7
Magnesium (meq/l)	1.4
Sodium (meq/l)	3.4
SAR	2.4
ESP	2.2
Calcium Carbonate Equiv.	0.81
Pyritic Sulfur	-
Particle Size Analysis	-
Very Fine Sand	-
Sand	49
Silt	41
Clay	10
Texture (USDA)	l

Analysis performed by Camp Dresser & McKee Inc.

Location of drill hole DH-1 is shown on Plates 26, 27 and 28.

LABORATORY ANALYSIS - ABERDEEN SEAM

DETERMINATION (%)	ROOF DH-1 472'7"-476'	DH-1 476'-477'7"	DH-6 2247'-2252'
pH (paste)	7.8	7.3	7.4
Electrical Conductivity @25°C (mmhos/cm)	0.67	0.5	2.2
Saturation Percentage	26	53	26
Calcium (meq/l)	0.35	0.79	2.9
Magnesium (meq/l)	0.20	0.38	9.8
Sodium (meq/l)	5.0	3.0	19
SAR	9.5	3.9	7.5
ESP	11	4.3	9.0
Calcium Carbonate Equiv.	0.98	0.91	8.8
Pyritic Sulfur	-	-	-
Particle Size Analysis	-	-	-
Very Fine Sand	-	-	-
Sand	64	83	65
Silt	23	11	25
Clay	13	6	10
Texture (USDA)	sc	ls	sl

DETERMINATION (%)	FLOOR DH-1 483'3"-488'3"	DH-6 2256'3"-2261'3"
pH (paste)	7.8	6.7
Electrical Conductivity @25°C (mmhos/cm)	1.3	0.96
Saturation Percentage	25	32
Calcium (meq/l)	0.38	2.8
Magnesium (meq/l)	0.14	2.9
Sodium (meq/l)	12	2.1
SAR	23	1.2
ESP	25	0.57
Calcium Carbonate Equiv.	0.81	0.45
Pyritic Sulfur	-	-
Particle Size Analysis	-	-
Very Fine Sand	-	-
Sand	58	81
Silt	28	11
Clay	14	8
Texture (USDA)	sl	ls

Analysis performed by Camp Dresser & McKee Inc.

Locations of drill holes DH-1, DH-5, and DH-6 are shown on Plates 26, 27 and 28.

B. ORIGINAL REPORT OF ANALYSIS

CDM

environmental engineers, scientists, planners, & management consultants

CAMP DRESSER & McKEE INC.

11455 West 48th Avenue
Wheat Ridge, Colorado 80033
303 422-0469

RECEIVED 2-9-81

February 6, 1981

Allen D. Emmel
Amca Coal Leasing, Inc.
P.O. Box 1027
Price, UT 84501

RE: 810-11742-14
Date Samples Recd 2-2-81

REPORT OF ANALYSIS

Lab Designation Sponsor Designation	810-11742-14-1 Lower Sunnyside Roof 55'7"-60'7"	810-11742-14-2 Lower Sunnyside Floor 65'-70'	810-11742-14-3 Gilson Roof 260'3"-265'3"	810-11742-14-4 Gilson Floor 272'4"-277'4"	810-11742-14- Aberdeen Roo 472'7"-476'
Determination (%)					
pH (paste)	7.0	3.8	7.5	6.9	7.8
Electrical Conductivity @25°C (mmhos/cm)	2.2	5.2	2.4	1.0	0.67
Saturation Percentage	30	32	28	26	26
Calcium (meq/l)	14	47	4.3	2.7	0.35
Magnesium (meq/l)	12	15	2.2	1.4	0.20
Sodium (meq/l)	2.0	0.68	19	3.4	5.0
SAR	0.55	0.12	10	2.4	9.5
ESP	-0.44	-1.1	12	2.2	11
Caclium Carbonate Equiv.	14	0.24	8.3	0.81	0.98
Pyritic Sulfur	-	0.28	-	-	-

Allen D. Emmel
February 6, 1981
Page 2

CAMP DRESSER & McKEE INC.

RE: 810-11742-14

REPORT OF ANALYSIS

Lab Designation Sponsor Designation	810-11742-14-1 Lower Sunnyside Roof 55'7"-60'7"	810-11742-14-2 Lower Sunnyside Floor 65'-70'	810-11742-14-3 Gilson Roof 260'3"-265'3"	810-11742-14-4 Gilson Floor 272'4"-277'4"	810-11742-14-5 Aberdeen Roof 472'7"-476'
Determination (%)					
Particle Size Analysis	-	-	-	-	-
Very Fine Sand	-	-	-	-	-
Sand	67	82	61	49	64
Silt	22	13	28	41	23
Clay	11	5	11	10	13
Texture - USDA	sl	ls	sl	l	sc

-101-

Allen D. Emmel
February 6, 1981
Page 3

RE: 810-11742-14

REPORT OF ANALYSIS

Lab Designation Sponsor Designation	810-11742-14-6 Aberdeen Roof 476'-477'7"	810-11742-14-7 Aberdeen Floor 483'3"-488'3"	810-11742-14-8 Lower Sunnyside 407'-412'	810-11742-14-9 Lower Sunnyside 418'2"-423'2"	810-11742-14 Lower Sunnys 1793'10"-179
Determination (%)					
pH (paste)	7.3	7.8	7.1	7.4	7.7
Electrical Conductivity @25°C (mmhos/cm)	0.5	1.3	3.2	2.6	1.2
Saturation Percentage	53	25	27	30	29
Calcium (meq/1)	0.79	0.38	19	6.7	1.1
Magnesium (meq/1)	0.38	0.14	23	6.3	1.1
Sodium (meq/1)	3.0	12	3.8	17	10
SAR	3.9	23	0.83	6.7	9.5
ESP	4.3	25	-0.04	7.9	11
Calcium Carbonate Equiv.	0.91	0.81	18	19	20
Pyritic Sulfur	-	-	-	-	-
Particle Size Analysis	-	-	-	-	-
Very Fine Sand	-	-	-	-	-
Sand	83	58	68	73	75
Silt	11	28	17	15	12
Clay	6	14	15	12	13
Texture (USDA)	ls	sl	sl	sl	sl

RE: 810-11742-14

REPORT OF ANALYSIS

Lab Designation Sponsor Designation	810-11742-14-11 Lower Sunnyside Roof 1796'6"-1798'10"	810-11742-14-12 Lower Sunnyside Floor 1802'9"-1809'9"	810-11742-14-13 Aberdeen Roof 2247'-2252'	810-11742-14-1[illegible] Aberdeen Floo[illegible] 2256'3"-2261'[illegible]
Determination (%)				
pH (paste)	7.6	3.6	7.4	6.7
Electrical Conductivity @25°C (mmhos/cm)	1.1	4.3	2.2	0.96
Saturation Percentage	34	34	26	32
Calcium (meq/l)	1.1	45	2.9	2.8
Magnesium (meq/l)	0.62	21	9.8	2.9
Sodium (meq/l)	9.8	1.3	19	2.1
SAR	11	0.23	7.5	1.2
ESP	12	-0.93	9.0	0.57
Calcium Carbonate Equivalent	15	0.38	8.8	0.45
Pyritic Sulfur	-	0.29	-	-

CAMP DRESSER & McKEE INC.

Allen D. Emmel
February 6, 1981
Page 5

RE: 810-11742-14

REPORT OF ANALYSIS

Lab Designation Sponsor Designation	810-11742-14-11 Lower Sunnyside Roof 1796'6"-1798'10"	810-11742-14-12 Lower Sunnyside Floor 1802'9"-1809'9"	810-11742-14-13 Aberdeen Roof 2247'-2252'	810-11742-14-14 Aberdeen Floor 2256'3"-2261'3"
Determination (%)				
Particle Size Analysis	-	-	-	-
Very Fine Sand	-	-	-	-
Sand	78	77	65	81
Silt	11	13	25	11
Clay	11	10	10	8
Texture - USDA	sl	sl	sl	ls

These samples are scheduled to be disposed of 90 days after the date of this report. Please notify us in writing if additonal storage time is needed. Extensions are subject to a storage charge.

BY Chris Shugarts

Chris Shugarts
Soils and Overburden Supervisor

CS/rjf

C. LETTER OF EXPLANATION

(CAMP DRESSER AND MCKEE)

CDM

environmental engineers, scientists, planners, & management consultants

CAMP DRESSER & McKEE INC.

11455 West 48th Avenue
Wheat Ridge, Colorado 80033
303 422-0469

February 13, 1981

Mr. Allen Emmel
AMCA Coal Leasing, Inc.
P.O. Box 1027
Price, Utah 84501

Dear Mr. Emmel:

I share your concern that the laboratory data we presented you did not correlate with your expectations. I hope the following explanation will clear up the major discrepancies.

In regards to the high amounts of sand found in all samples, we spot checked our results. We carried out sieve fraction analysis on sample number 2 (Lower Sunnyside floor material) and found 82% sand (2mm-0.05mm) which agreed with the result we previously found using the ASTM hydrometer method. The distribution of particle size fractions were found to be as follows:

medium sand (0.5mm-0.25mm)	13%
fine sand (0.25mm-0.1mm)	57%
very fine sand (0.1mm-0.05mm)	12%

In addition, over 50% of the medium sand was actually comprised of coal fragments. This preponderance of fine and very find sand can be obscured macroscopically and lead one to characterize the roof and floor material as carboniferous shale. I suspect that these fine and very find sands account for the discrepancy in the particle size classification between the laboratory and field workers.

Variation in the chemical data we presented can be accounted for by variation in lithology and oxidation. Samples 2 and 12 were found to have low pH values and significant quantities of pyritic sulfur, probably of the fine grained framboidal type. The acid generated from pyrite oxidation is neutralized by reaction with calcium carbonate and primary base containing minerals such as feldspars. High levels of calcium and magnesium in the saturated paste can be accounted for by the neutralization of calcium and magnesium carbonates respectively. When all the calcium and magnesium carbonate is consumed the pH normally drops and is generally buffered at between pH 3-4 by the gradual neutralization of primary minerals such as feldspars.

At these low pH values, an appreciable quantity of the calcium, magnesium and especially sodium and potassium may come from the acidic weathering of primary minerals. Thus the amount of pyrite and its degree of oxidation effects the levels of soluble salts. It is highly likely that variations in the amount, size and degree of pyrite oxidation can account for most of the variation in chemical composition between these samples.

I hope this explanation helps to clear up some of the questions you have. Please feel free to call back if you have further questions.

Sincerely,

Chris Shurgart for

Jim Robbins

JR/ca

Surface and Groundwater Hydrologic Inventory of the Tower Mine Plan and Adjacent Areas, Carbon County, Utah

The Centennial Project

Prepared for
TOWER RESOURCES, INCORPORATED
Price, Utah

February 1981

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SURFACE AND GROUNDWATER HYDROLOGIC INVENTORY OF THE TOWER MINE PLAN AND ADJACENT AREAS, CARBON COUNTY, UTAH

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2. GROUNDWATER HYDROLOGY

Regulations set forth by the U.S. Office of Surface Mining Reclamation and Enforcement (OSM) (Volume 44, number 50 of the Federal Register, dated Tuesday, March 13, 1979) and by the Utah Division of Oil, Gas, and Mining (DOGM) (Utah Code Annotated 40-10 et. seq.) require that water monitoring programs be established in areas of underground coal mining to monitor the effects of mining activities and protect the hydrologic balance of such areas. Therefore, a hydrologic investigation has been conducted on the mine plan area owned by Tower Resouces, Incorporated (hereinafter called the Tower mine plan area or mine plan area), which is currently developing coal resources by underground mining. The mine plan area, located north and east of Price, Utah in the Deadman Canyon area (see Figure 1), contains approximately 2240 acres of land. The project is entitled the Centennial Project.

2.1 Scope

The scope of the groundwater section of this report is to describe the existing groundwater hydrologic conditions of the Tower mine plan and adjacent areas and to describe the methods that have been and will be used to predict and monitor the impacts from mining. Sections within the groundwater section of this report will cover the following major topics: methodology, existing groundwater resources, groundwater development and mine

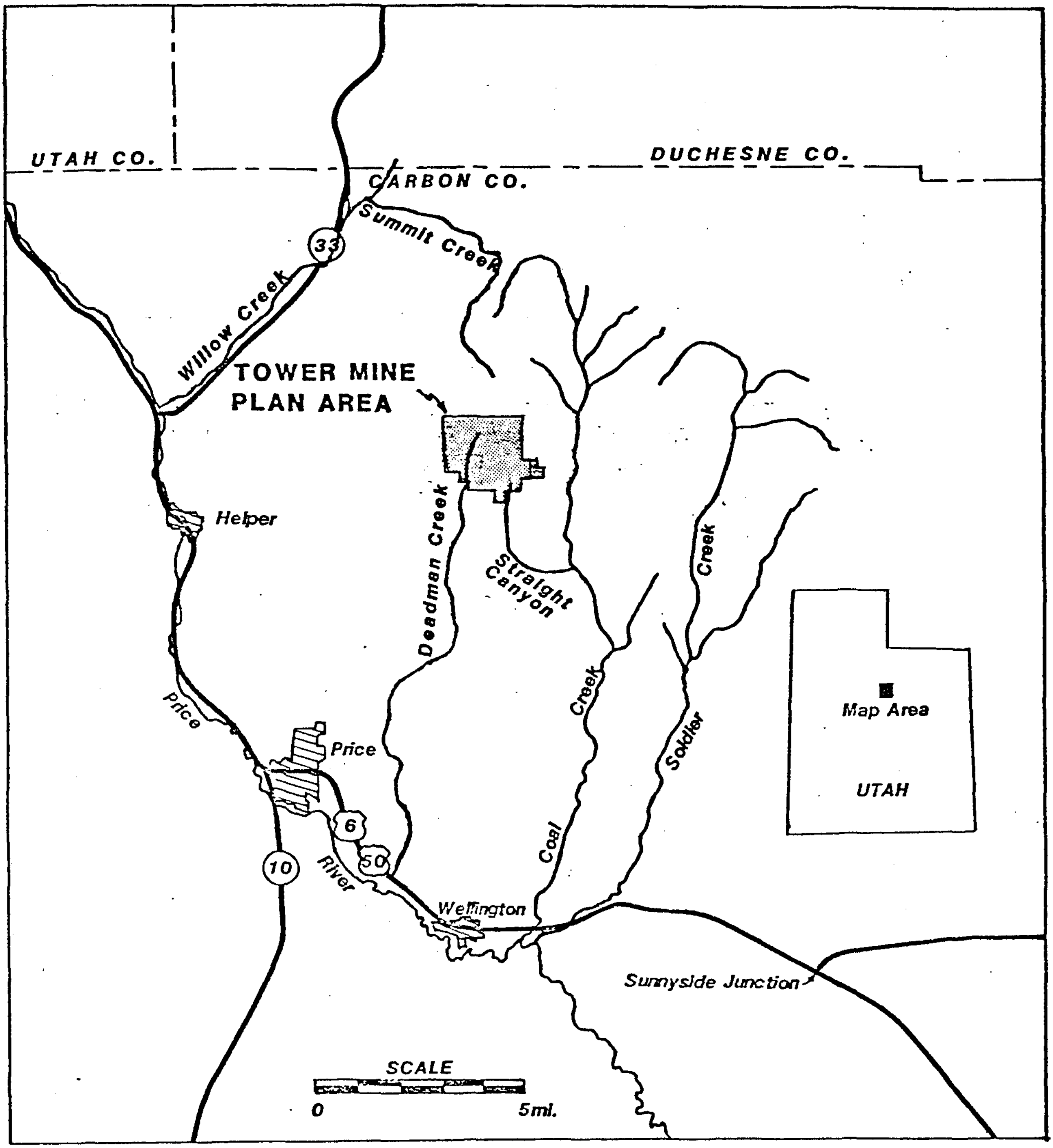

Figure 1. Location of the Tower mine plan area.

dewatering, effects of mining operation on the groundwater hydrologic balance, mitigation and control plans, and groundwater monitoring plans.

2.2 Methodology

Information used in preparing the groundwater hydrologic section of this report has been gathered by field investigations. Water quality samples have been collected and analyzed. Pertinent literature has been examined. In addition, experience of personnel working for the mine has been utilized to obtain pertinent information of conditions encountered underground.

All water quality samples have been and will continue to be analyzed by a certified laboratory. Attachment A lists the laboratory methods used for sample analyses. Pumping tests have been used on the existing water wells. Water rights were determined by examining current records of the Utah Division of Water Rights.

2.3 Existing Groundwater Resources

This section of the report deals with the groundwater resources of not only the Tower mine plan area, but also of the region as a whole. An understanding of geology as it relates to groundwater hydrology is very important, and consequently will be discussed briefly.

2.3.1 Regional Groundwater Hydrology

The Tower mine plan area is located within the Book Cliffs coal field, which extends from the Utah-Colorado state line to Castlegate, Utah. The general dip of the strata in the vicinity of the mine plan area is to the north and east at approximately 10 percent (6 degrees) (Doelling, 1972). The strike of the strata coincides in general with the trend of the cliffs (Spieker, 1925).

Geologic formations exposed within the mine plan area are the Blackhawk and Price River formations of the Mesaverde Group and the North Horn and Flagstaff members of the Wasatch Formation (see Figures 2 and 3).

Blackhawk Formation. The Blackhawk Formation, which directly overlies the Mancos Shale in the vicinity of the Tower mine plan area (Doelling, 1972), is the middle and coal bearing unit of the Mesaverde Group. The Blackhawk consists of a basal sandstone (the Aberdeen Sandstone), overlain by massive beds of gray to buff sandstone with alternating beds of sandy shale, shale, and coal (Clark, 1928), In the vicinity of the Tower mine plan area, the Blackhawk Formation is about 1000 feet thick (Doelling, 1972).

According to Clark (1928, p. 19):

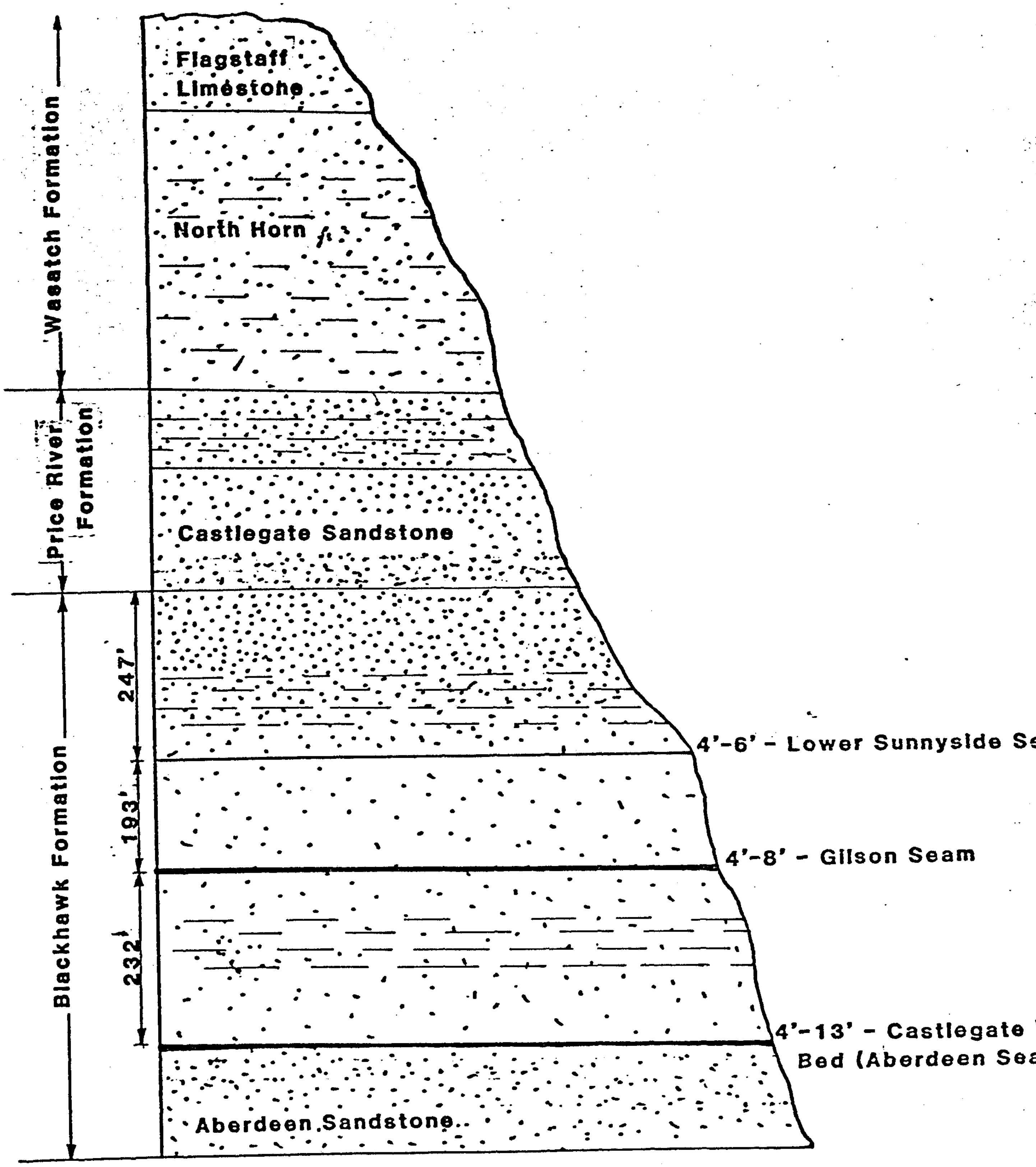

Figure 3. Generalized columnar section of the Tower mine plan area (Doelling, 1972).

> The coal bearing part of the Blackhawk Formation consists of massive beds of gray to buff sandstone, alternating with smaller amounts of sandy shale, shale and coal beds. The sandstone is composed largely of semirounded quartz grains cemented by carbonate of lime and is reasonably well consolidated but not greatly indurated except some of the fine-grained and highly calcareous beds. The shale, as a rule, is more or less sandy and adjacent to the coal beds usually contains some carbonaceous material. The coal beds have been extensively burned at the surface, and the associated rocks are greatly altered in character and composition. At many places where coal beds have burned, the rocks overlying them have fused, and everywhere they are predominantly red instead of gray and buff, their original colors.
>
> The dominant feature of the coal-bearing part of the Blackhawk Formation consists of the massive, cliff-forming beds of sandstone, which lie beneath many of the principle coal beds. Some of these sandstones beds are exposed for 20 to 30 miles in east-west extent.

The presence of shale layers in the Blackhawk Formation acts as an effective barrier to the vertical movement of the water within the formation. Therefore, water penetrating into the Blackhawk probably percolates downward until it encounters a shale layer, which then causes horizontal movement to the surface or to another sandstone finger within the formation.

Price River Formation. Overlying the Blackhawk Formation is the Price River Formation; composed of a massive basal sandstone, (referred to as the Castlegate Sandstone) and upper beds overlying the Castlegate (Clark, 1928).

The Castlegate Sandstone consists of massive, fine-grained to medium-grained sandstone beds (Doelling, 1972) which are gray to buff and composed mainly of semirounded grains of quartz (Clark, 1928). The basal portion of the Castlegate is a transition zone from sandy shale to sandstone and in many areas shale and sandy shale are encountered near the top of the sandstone bed (Clark, 1928). The Castlegate Sandstone is approximately 250 feet thick near the Tower mine plan area (Doelling, 1972).

The upper portion of the Price River Formation consists of two or more thick beds of sandstone, interbedded with thin-bedded shale and sandy shale (Clark, 1928). The sandstone layers are massive, white to gray beds, consisting of semi-angular grains of quartz. The shales are predominantly gray in color with occasional traces of olive-green shales in certain areas (Doelling, 1972).

North Horn Formation. The North Horn Formation, the lower-most member of the Wasatch Formation, consists of a series of shale, sandstone, minor conglomerate and freshwater limestone. The shales vary from yellow to gray or gray-green in color and are usually calcareous and silty (Doelling, 1972; Clark, 1928). The sandstones are tan to yellow-gray, fine to coarse-grained conglomerate sandstones with interbedded highly colored sandy shale (Clark, 1928). Limestone increases near the upper portion of the member (Doelling, 1972). Near the Tower mine plan area, the North Horn is about 600 feet thick.

Flagstaff Limestone. The Flagstaff Limestone, also a member of the Wasatch Formation, consists of thin-bedded limestones, shales, and sandstones (Doelling, 1972). The varicolored shales are interbedded with lacustrine and microcrystalline limestone. The sandstones are fine-grained to medium-grained, reddish-brown, and generally less plentiful than the other constituents (Doelling, 1972). The Flagstaff Limestone surfaces just north of the mine plan area on the plateau (Figure 2).

Faults. There are no faults known to exist within the Tower mine plan area. No major faults exist in the area adjacent to the mine plan area, however Doelling (1972) shows that one minor fault may exist about one-half mile south of the portal area.

Groundwater. The principal factor controlling the occurrence and availability of groundwater in any area is geology. As noted by Price and Waddell (1972), nearly all of the region surrounding the Tower mine plan area is underlain by rocks of continental and marine origin, consisting predominately of interbedded sandstones and shales. Although some of the sandstones in the region serve as the principal water-bearing strata, their ability to yield water for extended periods of time is largely controlled by the fact that the sandstone beds are relatively impermeable and by the existence of the impermeable interbedded shale layers, which prevent the downward movement of a significant amount of water.

According to the U.S. Geological Survey (1979), groundwater in the region exists under water table, artesian, and perched conditions. Water table conditions exist primarily in shallow alluvial deposits along larger perennial streams and in relatively flat lying sedimentary rocks. Artesian conditions exist at greater depths where a confining layer overlies a more permeable member. However, pressures are generally not sufficient to produce flowing wells. Perched or impeded conditions exist where the confining layer lies beneath the water bearing strata.

2.3.2 Mine Plan Area Aquifers.

Springs and seeps. Springs and seeps were inventoried within and adjacent to the Tower mine plan area to obtain an index of groundwater hydrologic conditions in the area. The inventory was conducted during the fall of 1980 during which time the mine plan area was walked and flown over, and seeps and springs found are shown on Figure 4. A field analysis was made of each spring, including discharge, water temperature, and conductivity measurements. A water quality sample was collected and analyzed from each spring found near the mine plan area. The results of these analyses are found in Attachment B and shown graphically on the map in Figure 4.

No springs were found on the Tower mine plan area. One small spring was identified about one-half mile south of the portal area. A spring was also located about one mile northeast of the mine plan area adjacent to Clearwater Creek. Flows measured in these springs ranged considerably as a result of recent precipitation. Flow at S18-1 changed from almost no flow to 13 gpm (0.03 cfs). Spring S34-1 had a flow rate of 10 gpm (0.02

cfs). Four small ponds about a mile north of the mine plan area boundary were sampled. These ponds may be partially fed by springs during part of the year. However, it appeared at the time of sampling that the water in these ponds probably was stored storm runoff.

Wells. Water for use by the mine is supplied from two wells located near the portal area and shown on Figure 4. Some data was obtained from pumping tests on these wells. Well #1 is 130 feet deep and had a static water level of 58 feet. After four hours of pumping at 50 gpm, the water level had been lowered to 67 feet. In January 1981, after about three months of use, this well was almost dry. Recharge is very meager. These facts seem to substantiate the lenticularity and tightness of the formation. It appears that the aquifer supplying the well was perched and very small and thus does not produce a sustained yield even though the initial pump test appeared favorable. This well is now being deepened in an attempt to improve the yield.

Well #2 was initially drilled to a depth of 155 feet and had a static water level at 57 feet. After two hours of pumping at 30 gpm, the level was lowered to 88 feet. The well was then drilled to a depth of 280 feet and pumped again. This second pump test produced almost twice as much drawdown with only one-half as much pumping as the first test. After only one hour of pumping at the same rate of 30 gpm the water level had dropped from 57 feet to 100 feet. The flow at the end of the pump test was only 25 gpm.

These results also seem to show that the water is perched and is quite limited in extent. After three weeks of pumping, in February 1981, this well also almost dried up. Recharge is very slow.

Groundwater Quality. Water quality samples were collected and analyzed from the two identified small springs referred to previously (S18-1 and S34-1). In addition, water quality samples have been obtained from Well #1 and Well #2. The results of the chemical analyses are presented in Attachment B and in Figure 4.

Groundwater from spring S18-1 varied with the four samples collected from a sodium-sulfate, to a magnesium-sulfate, and then to a magnesium-bicarbonate type. Total dissolved solids (TDS) levels ranged from 840 to 1560 milligrams per liter. Flows ranged from just a seep to only 13 gpm (0.03 cfs). Quality of the water improved with time even though flow generally decreased. This improvement in quality is not expected to be a long-term trend, but more likely is a seasonal variation or a short-term fluctuation. Water in spring S34-2 had a TDS level of 465 milligrams per liter and was a magnesium-bicarbonate. TDS levels in Well #1 and Well #2 were 1164 and 846 milligrams per liter respectively. The sample from Well #1 was a calcium-sulfate while the sample from Well #2 was a magnesium-bicarbonate. The average TDS concentration from all groundwater samples collected was 998 milligrams per liter. The general trend was for the highest quality water to come from the higher elevation station, and the lowest quality water to come from the lowest elevation station. This trend is consistent with the trend found in the Book Cliffs and Wasatch Plateau region as a whole. As water percolates down through the formations, quality of the groundwater decreases as constituents are picked up from the formations. Springs issuing from the shallow sandstones are primarily calcium-bicarbonates. As water seeps through the shales, the water gradually picks up more magnesium and sulfate ions, and the total dissolved solids concentrations increase.

Trace metal concentrations were all relatively low except for one sample from Well #1 which had a relatively high total boron concentration of 2.68 milligrams per liter (dissolved boron was not measured). All other boron concentrations were significantly lower. Groundwater ortho-phosphate concentrations ranged from less than 0.001 milligrams per liter at S18-1 and S34-1 to 0.05 milligrams per liter at S18-1. The highest nitrate level was only 1.06 milligrams per liter at S18-1. Hydrogen ion activity as measured by pH ranged from 7.1 to 7.7 in the groundwater samples.

2.4 Groundwater Development and Mine Dewatering.

This section of the report discusses the groundwater supply and usage in the mine plan and adjacent areas as well as the plan for use of water within the mine.

2.4.1 Water Supply

The Book Cliffs, where the Tower mine plan area is located, and the adjacent Wasatch Plateau act as recharge areas for regional groundwater systems (Price and Arnow, 1974). Only a small portion of the annual precipitation, probably much less than five percent, recharges the groundwater supply (Price and Arnow, 1974; U.S. Geological Survey, 1979). The depth of water infiltrating through the surface to saturated beds is small due to the presence of the relatively impermeable shale layers near the surface over much of the area and to the potential evapotranspiration being greater than the rainfall.

Price and Arnow (1974) indicate that properly constructed wells in the Price River Basin would have only limited yields (normally less than 50 gpm). Wells immediately adjacent to the Tower mine plan area could normally be expected to yield less than 10 gallons per minute (Price and Wadell, 1973). Increased yields could possibly be expected from wells penetrating highly fractured sandstones.

Rocks in the mountainous areas near the Tower mine plan area generally have low specific yields (0.2 to 0.7 percent) and low hydraulic conductivities (Price and Waddell, 1973). The volume of recoverable water in the area is small, averaging less than 600 acre-feet per square mile in the upper 100 feet of saturated rock (Price and Arnow, 1974).

The quality of groundwater in the Price River Basin deteriorates with distance downstream much the same as surface water. Dissolved solids concentrations in groundwater range from less than 500 milligrams per liter near the Tower mine plan area to 3000 milligrams per liter or more near the confluence of the Price River with the Green River (Price and Waddell, 1973). This increase in dissolved solids concentration is the result of increased contact of water and rock as travel distance increases, with saline shales contributing a major portion of the dissolved constituents.

Water Rights. Groundwater rights in and adjacent to the Tower mine plan area on file as of February 1981 with the Utah Division of Water Rights are listed in Table 1 and shown in Figure 5. All groundwater rights on or adjacent to the mine plan area are specified for use as stockwater except for the water rights obtained for use in Tower's mine.

2.4.2 Mine Dewatering

Very little water has been encountered in the Pinnacle Mine (the currently operating mine within the Tower mine plan area). Water that has been encountered has been in the form of very small roof leakers that dry up within a few days or weeks after mining progresses downdrift. If any usable supplies of water are encountered as mining progresses, they will be stored and used within the mine. No mine water has been discharged nor is any water expected to be discharged in the future.

Table 1. Groundwater rights located on and adjacent to the Tower mine plan area.

Water Use Claim No.	Owner	Source	Flow (cfs)	Purpose of Use	Period of Use
91-351	Funnon T. and Donna Shimmin	Unnamed Spring	.011	Stockwatering	May 1 to November 30
91-844	J. D. & Inez Critchlow	Unnamed Spring	.011	Stockwatering	March 1 to November 30
91-856	Jay L. Critchlow (1/2 interest)	Unnamed Spring	.011	Stockwatering	March 1 to November 30
91-859	Jay L. Critchlow (1/2 interest)	Unnamed Spring	.011	Stockwatering	March 1 to November 30
91-861	Jay L. Critchlow (1/2 interest)	Unnamed Spring	.011	Stockwatering	March 1 to November 30
91-884	John C. Critchlow (1/2 interest)	Unnamed Spring	.011	Stockwatering	March 1 to November 30
91-887	John C. Critchlow (1/2 interest)	Unnamed Spring	.011	Stockwatering	March 1 to November 30
91-889	John C. Critchlow (1/2 interest)	Unnamed Spring	.011	Stockwatering	March 1 to November 30
91-1194	Vera T. Shimmin	Clear Water Cabin Spring	.011	Stockwatering	May 1 to November 30
91-1196	Vera T. Shimmin	Unnamed Spring	.011	Stockwatering	May 1 to November 30
91-1202	Vera T. Shimmin	Unnamed Spring	.011	Stockwatering	May 1 to November 30
91-1205	Funnon T. & Donna Shimmin	Big Summit Spring No. 1	.011	Stockwatering	May 1 to November 30
91-1206	Funnon T. & Donna Shimmin	Big Summit Spring No. 2	.011	Stockwatering	May 1 to November 30
91-1213	Funnon T. & Donna Shimmin	Unnamed Spring	.011	Stockwatering	May 1 to November 30
91-1214	Funnon T. & Donna Shimmin	Wild Cattle Spring	.011	Stockwatering	May 1 to November 30
91-1216	Funnon T. & Donna Shimmin	Buck Meadow Spring	.011	Stockwatering	May 1 to November 30
91-1220	John A. Mathis	Unnamed Spring	.011	Stockwatering	April 1 to November 30
91-1228	Rex Mathis	Buck Creek Spring	.011	Stockwatering	May 1 to November 30
91-1230	Rex Mathis	Tank Spring	.022	Stockwatering	May 1 to November 30
91-1233	Rex Mathis	Fork of Big Summit Spring	.011	Stockwatering	April 1 to November 30

Table 1. Continued.

Water Use Claim No.	Owner	Source	Flow (cfs)	Purpose of Use	Period of Use
91-1235	Rex Mathis	Unnamed Spring	.011	Stockwatering	April 1 to November 30
91-1378	Ezra Branch	Unnamed Spring	.011	Stockwatering	May 1 to November 30
91-2571	U.S. Bureau of Land Management	Fish Creek Spring	.033	Stockwatering	January 1 to December 31
91-2572	U.S. Bureau of Land Management	Straight Canyon Spring	.033	Stockwatering	January 1 to December 31
91-4171	AMCA Coal Leasing	4 wells	.5	Underground Mining	January 1 to December 31
91-4173	AMCA Coal Leasing	Olsen Mine	.2	Underground Mining	January 1 to December 31

2.5 Effects of Mining Operation on the Groundwater Hydrologic Balance

As has been noted, the occurence and quality of water in any region is highly controlled by geology. The geology of the Tower mine plan area, as evidenced by similar areas in the Book Cliffs and the Wasatch Plateau is such that the effects on groundwater by mining activities will have very little adverse impact on the areal hydrologic system.

As shown in Figure 2, the Tower mine plan area is extremely rugged. The area is characterized by steep rocky slopes and narrow ridges. The cover over the recoverable coal reserves ranges from 0 to 2200 feet.

Geologic Formations. As discussed previously, the highest terrain is composed of the Flagstaff Limestone and North Horn members of the Wasatch Formation. The recoverable coal reserves are contained within the Blackhawk Formation which lies on top of the Mancos Formation. These formations above the Mancos are layers of sandstone interbedded with shale and are lenticular. The sandstones in the formation are well cemented and tight due to the roundness of grains.

The dip of the formation is about six degrees in a north-northeast direction. There are no known faults within the mine plan area.

Springs. No springs were located in the initial field survey on the mine plan area. Most precipitation enters the soil and is used by the vegetation. As mentioned earlier, only two springs were located adjacent to the Tower mine plan area. Flows ranged from almost zero to 13 gpm (0.03 cfs) (see Section 2.3.2). The formations are very lenticular, and a few small, perched aquifers exist over the mine plan area. Both springs that have been found are located near the base of a dominant sandstone formation. Spring S18-1 issues near the interface between a unit within the Mancos shale and the impermeable shale below (Glasson, 1981). Spring S34-1 issues near the interface between the North Horn Formation and the upper portion of the Price River Formation. This is consistent with the pattern shown throughout the whole region. Shale layers (such as the Mancos Shale or a shale bed in the Price River Formation) act as impeding members to deep percolation, sometimes forcing at least a portion of the water that percolates through the soil mantle to move somewhat horizontally to be discharged at the surface as spring water. The lack of springs in the Tower mine plan area consequently indicates the lack of much water percolating in through the soil mantle.

2.6 Mitigation and Control Plans

As was previously discussed, no significant impacts to the groundwater system are expected from the mining operation.

2.7 Groundwater Monitoring Plan

This groundwater monitoring plan supercedes the one mentioned in the original permit application. Because of limited groundwater in the Tower mine plan area and the absence of springs in the area, a simple groundwater monitoring plan is justified. The two wells shown on Figure 6 are the only current diversion points of groundwater within the mine plan area. The groundwater will be sampled by sampling the water produced out of these wells (depending on which one, if any is producing water at the time). Because of the remoteness of the spring north of the mine plan area from the mining operation, sampling of this source is not considered to be necessary. Groundwater samples will also be obtained from within the mine if significant amounts of water are encountered. S18-1 will also be monitored. Other monitoring wells have previously been proposed, but based on the results of this study, it is felt that the information that may be obtained from these wells is not very useful.

Water quality samples will be collected monthly during the 1981 baseline period. Beginning in 1982, sampling will be conducted on a quarterly basis. Each sample collected will be analyzed as outlined by the list contained in Table 2 with the exception of suspended solids. Measurements taken from the mine will give an indication of quality impacts on the deep groundwater system. The derivation of Table 2 was based on the need to clarify background conditions and future impacts. Suspended solids has been included in the abbreviated schedule as the single most

Table 2. Water Quality analytical schedule.

Field Measurements	Laboratory Measurements	
Discharge	Acidity	Manganese, Total
pH	Alkalinity	Nitrate (NO_3 as N)
Specific Conductance	Ammonia	Oil & Grease (as appropriate)
Temperature, Air	Bicarbonate	Potassium
Temperature, Water	Calcium	Sodium
	Carbonate	Sulfate
	Chloride	Total Dissolved Solids
	Iron, Dissolved	Total Suspended Solids*
	Iron, Total	
	Magnesium	

* Surface waters only

important impact indicator for surface waters. Ammonia and phosphate are included because of the high background concentrations found previously. Total dissolved solids, specific conductance, temperature, and the major cations and anions are included as indexes of major change. Total iron, dissolved iron, total manganese, nitrate. oil and grease, and pH determinations are required by OSM regulations and/or DOGM regulations.

Groundwater monitoring will continue on a quarterly basis during post mining operations until the reclamation effort is approved by the regulatory agency.

As required, groundwater quality data collected from the mine plan area will be submitted to the Utah Division of Oil, Gas, and Mining. Such reports will normally be submitted within 60 days of the ends of each quarter, depending upon the speed of laboratory analyses.

3. SURFACE WATER HYDROLOGY

As was explained under Section 2, OSM and DOGM regulations require that water monitoring programs be established in areas of underground coal mining to monitor the effects of mining activities and protect the hydrologic balance of such areas. This section of this report outlines the surface water hydrologic investigation conducted on the Tower mine plan area.

3.1 Scope

The scope of this surface water section of this report is to describe the existing hydrologic conditions of the Tower mine plan and adjacent areas and to describe the methods that have been and will be used to predict, monitor, and mitigate the impacts of mining. Sections within this surface water section of this report will cover the following topics: methodology, existing surface water resources, surface water development, control and diversions, effects of mining on the surface water hydrologic balance, mitigation and control plans, and surface water monitoring plans.

3.2 Methodology

Information used in preparing the surface water hydrologic section of this report has been gathered by field investigations conducted both on the ground and by airplane. Pertinent literature has been examined. Water quality samples have been and will continue to be analyzed by a certified laboratory. Attachment A lists the laboratory methods used for sample analyses. Water rights were determined by examining current records of the Utah Division of Water Rights.

The mean annual water yield from the Tower mine plan area was calculated by two separate methods and compared with an estimate of the mean annual water yield given in Jeppson et al. (1968) to increase the level of confidence. The first method of calculation, referred to as "Grunsky's Rule", was originally developed by Grunsky (1908) and later adapted by Sellars (1965). In accordance with this method, the average annual water yield can be determined from

$$Q = \alpha P^2 \text{ [for } P \geq 1/(2\alpha) \text{]} \qquad (1)$$

or

$$Q = P - 1/(4\alpha) \text{ [for } P \geq 1/(2\alpha) \text{]} \qquad (2)$$

where Q is the mean annual water yield, in inches; P is the normal annual precipitation, in inches; and α is the runoff coefficient, in inches^{-1}. Alpha (α) was determined from guidelines set forth by Hawkins (1976). The second method of calculation is known as Ol'deKop's formula (Sellars, 1965). According to this method, the mean annual water yield is determined from

$$Q = P - E_o \tanh (P/E_o) \qquad (3)$$

where Q and P are as previously defined and E_o is the annual potential evapotranspiration, in inches.

3.3 Existing Surface Water Resources

This section of the report deals with the region in general and the Tower mine plan area more specifically. Watershed and stream characteristics are both described.

3.3.1 Regional Surface Water Hydrology

The Tower mine plan area is situated in the Book Cliffs near the headquarters of the Price River Basin. The mine plan area is drained by ephemeral creeks which flow towards the Price River.

Snowmelt is the major source of water for the perennial streams of the Price River Basin. Ephemeral streams are abundant in the basin, existing primarily at lower elevations where potential evapotranspiration exceeds precipitation (such as on the Tower mine plan area).

Water use upstream from Castle Valley (the monoclinal valley containing most of the agricultural land noted in Figure 7) is primarily for stockwatering and industrial purposes (coal mining and electrical power generation). Within Castle Valley, agriculture and power production utilize nearly all of the inflowing water (Mundorff, 1972), with minimum flows in the gaged streams and rivers in the basin occasionally reaching zero. Storage reservoirs are common at higher elevations. Transbasin diversions occur in the headwaters of the Price River.

In general, the chemical quality of water in the headwaters of the Price River Basin is excellent, with this watershed providing most of the domestic water needs of the people below. However, this quality rapidly deteriorates downstream as the streams cross shale formations (particularly the Mancos Shale in and adjacent to Castle Valley) and receive irrigation return flows from lands situated on Mancos-derived soils (Price and Waddell, 1973). Within the Price River Basin, for example, Mundorff (1972) reports that the Price River and its tributaries generally have a dissolved solids concentration of less than 400 milligrams per liter upstream from Helper. The water in this area is of a calcium-bicarbonate type. Between this point and the confluence with Miller Creek, most of the flows originate on or traverse Mancos shales. Much of the flow is derived from irrigation return flows. The Price River at Wellington, which is near the center of the basin, has an average dissolved solids content of about 1700 milligrams per liter and is of a mixed chemical type (calcium-magnesium-sodium-sulfate). At Woodside, which is about 22 miles upstream from the confluence of the Price River with the Green River, the weighted average dissolved solids content has generally been between 2000 and 4000 milligrams per liter, with the water type being strongly sodium-sulfate.

Sediment yield from the upper portion of the basin is probably negligible (Mundorff, 1972). According to the U.S. Soil

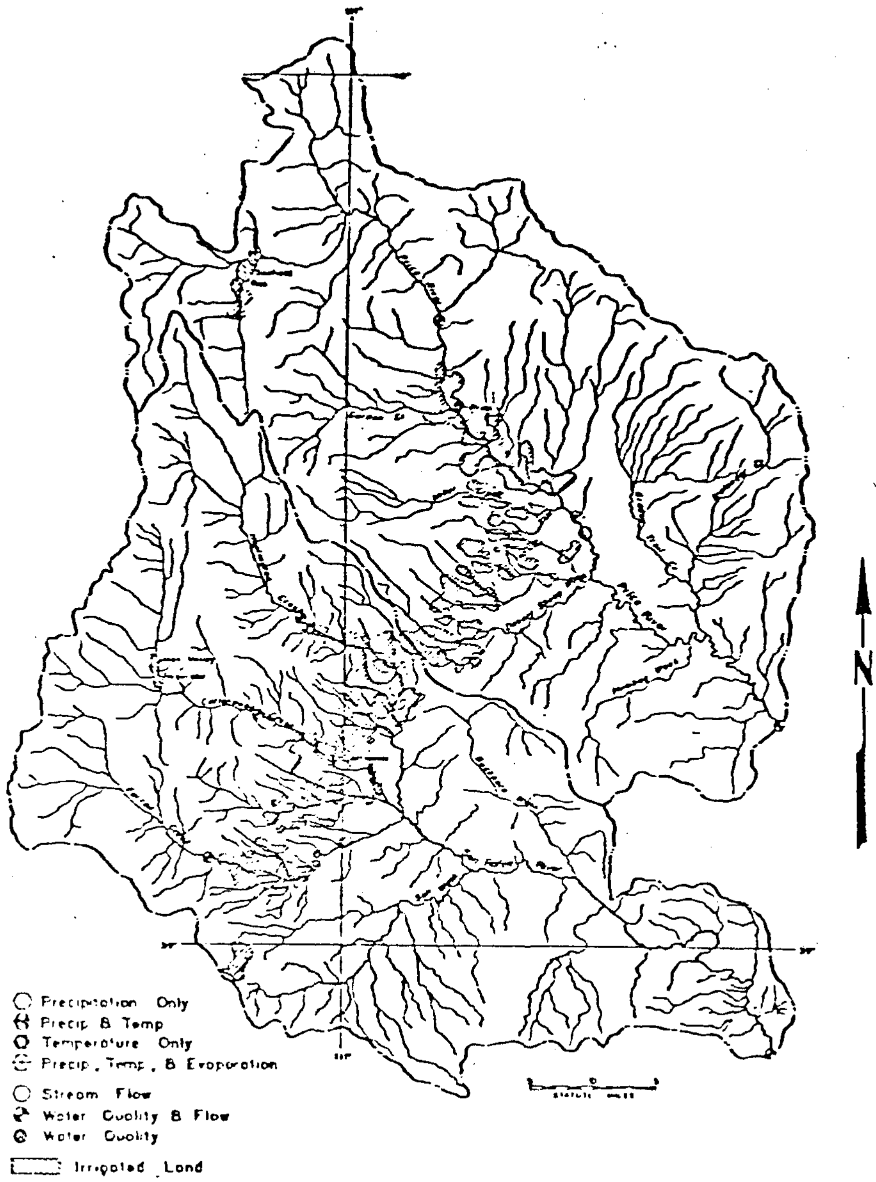

Figure 7. Price and San Rafael river basins (taken from Hyatt et al., 1970).

Conservation Service (1975), erosion rates in the Price and San Rafael River basins vary from 0.1 to 3.0 acre-feet per square mile per year. The bulk of the sediment yielded each year at the mouth of the Price River comes from limited areas covered with highly erodable shales (Mundorff, 1972).

3.3.2 Mine Plan Area Watersheds and Streams, Spring and Seep Characteristics, Stream Characteristics, and Watershed Characteristics

The Tower mine plan area is drained by ephemeral streams heading primarily in a southerly direction. The Right and Left forks of Deadman Creek drain the western portion of the mine plan area including the area of the surface facilities. Straight Canyon and Hoffman Creek drain the southeastern portion of the mine plan area and flow into Coal Creek. Coal Creek is a tributary of the Price River as is Deadman Creek. The northernmost part of the mine plan area on the Plateau drains toward Summit Creek which flows north and west into Willow Creek.

Topography in the area is generally very steep and rugged, with elevations varying from about 7200 feet to about 8500 feet above sea level. Slopes vary from vertical cliffs to less than 2 percent (1.2 degrees) on the plateau. The dominant aspect of the Tower mine plan area is to the south.

Water sources within or adjacent to the mine plan area consist of a few springs and ephemeral streams, which will be discussed in subsequent sections of this report. There are no major water bodies located within or adjacent to the mine plan area.

3.4 Surface Water Development, Control and Diversions

Because of the remoteness and the limited amount of surface water in and adjacent to the Tower mine plan area, essentially no development of the surface water has occurred except for some stock watering ponds on the north and in conjunction with runoff control facilities associated with the Pinnacle Mine. This section of the report deals with the surface water supply in the area. The supply will be discussed in terms of quantity, quality, and the water rights in the area. Runoff control facilities of the Pinnacle Mine are described in the permit application.

Flow Characteristics. According to Jeppson et al. (1968), the mean annual water yield for the Tower mine plan area is approximately one inch. Two other hydrologic methods (described in Section 3.2) were used to determine the mean annual water yield to increase the confidence level of the estimate. According to Grunsky's Rule, the mean annual water yield is less than zero which is obviously in error. According to Ol'deKop's formula (Sellars, 1965), the mean annual water yield from the mine plan area is 1.8 inches. These two methods utilize the information that mean annual precipitation and potential evapotranspiration over the mine plan area are 14 and 21 inches respectively (Jeppson et al., 1968). The estimated mean annual water yield from Ol'deKop's formula compares quite favorably with the estimate from the Hydrologic Atlas of Utah prepared by Jeppson et al. (1968).

As mentioned previously, the mine plan area drains in a generally southerly direction in ephemeral streams.

Surface Water Quality. Surface water quality data were collected during the fall and winter period of 1980 and 1981. Samples were collected from four stockwater ponds north of the mine plan area, a station at the mouth of Clearwater Creek and on Coal Creek east of the mine plan area (see Figure 4). Attachment A summarizes the analytical methods used in both the field and laboratory, and Attachment B contains the results of the chemical analyses of the samples. Cation-anion diagrams have been included on Figure 4 as indicators of general water quality.

Total dissolved solids concentrations of the surface water samples ranged from 200 to 330 milligrams per liter at the four high elevation ponds to 660 and 700 milligrams per liter at lower elevation on Clearwater and Coal creeks, respectively. This trend follows the strong regional trend for water quality to significantly deteriorate as the water flows down over the shales. Suspended solids ranged from a low of 2.0 milligrams per liter in Clearwater Creek to a high of 127 milligrams per liter in Coal Creek. Hydrogen ion activity (pH) of the monitored surface waters varied between 7.0 and 8.3 units. The basic nature of the waters is probably due to the high concentration of bicarbonates (American Public Health Association et al., 1976). Most natural waters are buffered to some extent by reactions involving dissolved carbon dioxide species, with the most effective buffering action from these species being within the range from 6.0 to 8.5 pH units. Therefore, the relatively constant and basic pH coupled with the low acidity and high alkalinity concentrations, indicates that waters in the area are not significantly influenced by pollution (Hem, 1970).

Dissolved iron concentrations ranged between 0.01 milligrams per liter at Station 33-1 to 0.06 milligrams per liter at three other ponds. Total iron concentrations ranged from 0.13 to 1.88 milligrams per liter at Stations 34-2 and 18-1, respectively. Total manganese concentrations varied from 0.015 to 1.22 milligrams per liter at Stations 33-1 and 34-2, respectively.

The Utah Division of Health has classified the waters within the Andalex mine plan area as 3C (protected for non-game fish and other aquatic life) and 4 (protected for agricultural uses including irrigation of crops and stockwatering). Tables 3 and 4 contain the numerical water quality standards applicable to these various classifications. Only one exceedance of these chemical standards by surface waters was noted from data gathered during the

Table 3. Utah Division of Health numerical standards for water in the State.

Constituent	Domestic Source 1A	1B	1C	Recreation & Aesthetics 2A	2B	Aquatic Wildlife 3A	3B	3C	3D	Agri- culture 4	Indus- try 5	Special 6
Bacteriological (no./100 ml)								STANDARDS WILL BE DETERMINED ON A CASE-BY-CASE BASIS (see Table 4)			STANDARDS WILL BE DETERMINED ON A CASE-BY-CASE BASIS	STANDARDS WILL BE DETERMINED ON A CASE-BY-CASE BASIS
(30-day Geometric Mean)												
Maximum Total Coliforms	1	50	5,000	1,000	5,000	•	•		•	•		
Maximum Fecal Coliforms	•	•	2,000	200	2,000	•	•		•	•		
Physical												
Total Dissolved Gasses	•	•	•	•	•	(b)	(b)		•	•		
Minimum DO (mg/l) (a)	•	•	5.5	5.5	5.5	6.0	5.5		5.5	•		
Maximum Temperature	•	•	•	•	•	20°C	27°C		•	•		
Maximum Temp. Change	•	•	•	•	•	2°C	4°C		•	•		
pH	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0		6.5-9.0	6.5-9.0		
Turbidity increase (c)	•	•	•	10 NTU	10 NTU	10 NTU	10 NTU		15 NTU	•		
Chemical (Maximum mg/l)												
Arsenic, dissolved	.05	.05	.05	•	•	•	•		•	.1		
Barium, dissolved	1	1	1	•	•	•	•		•	•		
Cadmium, dissolved	.010	.010	.010	•	•	.0004(d)	.004(d)		•	.01		
Chromium, dissolved	.05	.05	.05	•	•	.10	.10		.10	.10		
Copper, dissolved	•	•	•	•	•	.01	.01		•	.2		
Cyanide	•	•	•	•	•	.005	.005		•	•		
Iron, dissolved	•	•	•	•	•	1.0	1.0		1.0	•		
Lead, dissolved	.05	.05	.05	•	•	.05	.05		•	.1		
Mercury, total	.002	.002	.002	•	•	.00005	.00005		.00005	•		
Phenol	•	•	•	•	•	.01	.01		•	•		
Selenium, dissolved	.01	.01	.01	•	•	.05	.05		•	.05		
Silver, dissolved	.05	.05	.05	•	•	.01	.01		•	•		
Zinc, dissolved	•	•	•	•	•	.05	.05		•	•		
NH_3 as N (un-ionized)	•	•	•	•	•	.02	.02		•	•		
Chlorine	•	•	•	•	•	.002	.01		•	•		
Fluoride, dissolved (e)	1.4-2.4	1.4-2.4	1.4-2.4	•	•	•	•		•	•		
NO_3 as N	10	10	10									
Boron, dissolved	•	•	•	•	•	•	•		•	.75		
H_2S	•	•	•	•	•	.002	.002		•	•		
TDS (f)	•	•	•	•	•	•	•		•	1200		
Radiological (Maximum pCi/l)												
Gross Alpha	15	15	15	•	•	15(g)	15(g)		15(g)	15(g)		
Radium 226, 228 combined	5	5	5	•	•	•	•		•	•		
Strontium 90	8	8	8	•	•	•	•		•	•		
Tritium	20,000	20,000	20,000	•	•	•	•		•	•		
Pesticides (Maximum ug/l)												
Endrin	.2	.2	.2	•	•	.004	.004		.004	•		
Lindane	4	4	4	•	•	.01	.01		.01	•		
Methoxychlor	100	100	100	•	•	.03	.03		.03	•		
Toxaphene	5	5	5	•	•	.005	.005		.005	•		
2, 4-D	100	100	100	•	•	•	•		•	•		
2, 4, 5-TP	10	10	10	•	•	•	•		•	•		
Pollution Indicators (g)												
Gross Beta (pCi/l)	50	50	50	•	•	50	50		50	50		
BOD (mg/l)	•	•	5	5	5	5	5		5	5		
NO_3 as N (mg/l)				4	4	4	4		•	•		
PO_4 as P (mg/l)(h)	•	•	•	.05	.05	.05	.05		•	•		

* Insufficient evidence to warrant the establishment of numerical standard. Limits assigned on case-by-case basis.

(a) These limits are not applicable to lower water levels in deep impoundments.

(b) Not to exceed 110% of saturation.

(c) For Classes 2A, 2B, 3A, and 3B at background levels of 100 NTUs or greater, a 10% increase limit will be used instead of the numeric values listed. For Class 3D at background levels of 150 NTUs or greater, a 10% increase limit will be used instead of the numeric value listed. Short term variances may be considered on a case-by-case basis.

(d) Limit shall be increased threefold if $CaCO_3$ hardness in water exceeds 150 mg/l.

(e) Maximum concentration varies according to the daily maximum mean air temperature.

Temp. °C	mg/l
12.0 and below	2.4
12.1 to 14.6	2.2
14.7 to 17.6	2.0
17.7 to 21.4	1.8
21.5 to 26.2	1.6
26.3 to 32.5	1.4

(f) Total dissolved solids (TDS) limit may be adjusted on a case-by-case basis.

(g) Investigations should be conducted to develop more information where these pollution indicator levels are exceeded.

(h) PO_4 as P(mg/l) limit for lakes and reservoirs shall be .025.

Table 4. Numerical standards for class 3C water use.

Physical	
Minimum D.O. (mg/l)	5
Maximum Temperature	27°C
Maximum Temperature Change	4°C
pH	6.5-9.0
Turbidity Increase (NTU)	15****
Chemical (Maximum Mg/l)	
Cadmium, dissolved	0.004
Chromium, dissolved	0.1
Copper, dissolved	0.01
Cyanide	0.005
Iron, dissolved	1.0
Lead, dissolved	0.05
Mercury, total	0.0005
Phenol	0.01
Selenium, dissolved	0.05
Silver, dissolved	0.01
Zinc, dissolved	0.05
Chlorine	0.2
H_2S	0.02
Radiological (Maximum pCi/l)	
Gross Alpha	15
Gross Beta	30
Pesticides (Maximum mg/l	
Endrin	0.004
Lindane	0.01
Methoxychlor	0.03
Toxaphene	0.005
Pollution Indicators***	
BOD (mg/l)	5.0
NO_3 as N (mg/l)	4.0

***Investigations should be conducted to develop more information where these pollution indicator levels are exceeded.

****At background levels of 150 NTU's or greater, a 10% increase limit will be used instead of the numeric values. Short term variances may be considered on a case-by-case basis.

hydrologic inventory (dissolved copper was measured at 0.02 milligrams per liter at Station 32-1).

Water Rights. Surface water rights in and adjacent to the Tower mine plan area on file as of February 1981 with the Utah Division of Water Rights are listed on Table 5 and shown on Figure 5. All surface water rights in the area are for stockwatering uses except for one irrigation diversion on Coal Creek slightly over a mile southeast of the mine plan area.

3.5 Effect of Mining on the Surface Water Hydrologic Balance

As has been previously mentioned in this report, the occurrence and quality of water in any region is highly controlled by geology. It is felt that mining activities will have insignificant adverse impact on the areal hydrologic system.

3.5.1 Quantity

As mentioned earlier in the report, the major ephemeral drainages conveying runoff away from the mine plan area are the Right and Left Forks of Deadman Canyon, Straight Canyon, and Hoffman Creek. The surface facilities are located in the Right Fork of Deadman Canyon. No mine water will be discharged into surface streams, as any that may be encountered will be used within the mine. As a result, it is felt that the mining operation will have no significant impact on the surface water system.

Table 5. Surface water rights located on and adjacent to the Tower mine plan area.

Water Use Claim No.	Owner	Source	Flow (cfs)	Purpose of Use	Period of Use
91-340	George M. & Ardith Thayn	Coal Creek	----	Stockwatering	January 1 to December 31
91-761	George M. & Ardith Thayn	Coal Creek	2.0	Irrigation	April 1 to October 31
91-843	J. D. and Inez Critchlow	Unnamed Stream	----	Stockwatering	March 1 to November 30
91-845	J. D. and Inez Critchlow	Unnamed Stream	----	Stockwatering	March 1 to November 30
91-846	J. D. and Inez Critchlow	Unnamed Stream	----	Stockwatering	March 1 to November 30
91-847	J. D. and Inez Critchlow	Unnamed Stream	----	Stockwatering	March 1 to November 30
91-854	Jay L. Critchlow (1/2 Interest)	Unnamed Stream	----	Stockwatering	March 1 to November 30
91-855	Jay L. Critchlow (1/2 Interest)	Unnamed Stream	----	Stockwatering	March 1 to November 30
91-857	Jay L. Critchlow (1/2 Interest)	Unnamed Stream	----	Stockwatering	March 1 to November 30
91-858	Jay L. Critchlow (1/2 Interest)	Unnamed Stream	----	Stockwatering	March 1 to November 30
91-860	Jay L. Critchlow (1/2 Interest)	Unnamed Stream	----	Stockwatering	March 1 to November 30
91-882	John C. Critchlow (1/2 Interest)	Unnamed Stream	----	Stockwatering	March 1 to November 30
91-883	John C. Critchlow (1/2 Interest)	Unnamed Stream	----	Stockwatering	March 1 to November 30
91-885	John C. Critchlow (1/2 Interest)	Unnamed Stream	----	Stockwatering	March 1 to November 30
91-886	John C. Critchlow (1/2 Interest)	Unnamed Stream	----	Stockwatering	March 1 to November 30
91-898	John C. Critchlow (1/2 Interest)	Unnamed Stream	----	Stockwatering	March 1 to November 30
91-1187	Funnon T. & Donna Shimmin	Big Summit Creek	----	Stockwatering	May 1 to November 30
91-1198	Funnon T. & Donna Shimmin	Big Summit Creek	----	Stockwatering	May 1 to November 30
91-1195	Vera T. Shimmin	Clear Water Creek	----	Stockwatering	May 1 to November 30
91-1197	Vera T. Shimmin	Clear Water Creek	----	Stockwatering	May 1 to November 30
91-1203	Vera T. Shimmin	Big Summit Creek	----	Stockwatering	May 1 to November 30
91-1204	Vera T. Shimmin	Big Summit Creek	----	Stockwatering	May 1 to November 30

Table 5. Continued.

Water Use Claim No.	Owner	Source	Flow (cfs)	Purpose of Use	Period of Use
91-1209	Funnon T. & Donna Shimmin	Clear Water Creek	----	Stockwatering	May 1 to November 30
91-1212	Funnon T. & Donna Shimmin	Unnamed Stream	----	Stockwatering	May 1 to November 30
91-1215	Funnon T. & Donna Shimmin	Unnamed Stream	----	Stockwatering	May 1 to November 30
91-1227	Rex Mathis	Buck Creek	----	Stockwatering	May 1 to November 30
91-1229	Rex Mathis	Buck Creek	----	Stockwatering	May 1 to November 30
91-1231	Rex Mathis	Tributary to Antone Creek	----	Stockwatering	April 1 to November 30
91-1232	Rex Mathis	Tributary to Antone Creek	----	Stockwatering	April 1 to November 30
91-1234	Rex Mathis	Unnamed Stream	----	Stockwatering	April 1 to November 30
91-1237	Rex Mathis	Antone Creek	----	Stockwatering	April 1 to November 30
91-1372	Ezra Branch	Clear Water Creek	----	Stockwatering	May 1 to November 30
91-1567	Rex Mathis	Tributary to Antone Creek	----	Stockwatering	April 1 to November 30
91-1942	John A. Mathis	Clear Water Creek	----	Stockwatering	April 1 to November 30
91-2570	U.S. Bureau of Land Management	Coal Creek	----	Stockwatering	January 1 to December 31
91-2575	U.S. Bureau of Land Management	Coal Creek	----	Stockwatering	January 1 to December 31
91-3663	Big Summit Creek	Jay L. Critchlow	----	Stockwatering	March 1 to November 30

3.5.2 Quality

The quality of flow from the headwaters of the Price River Basin is excellent. However, this quality rapidly deteriorates downstream as the stream crosses shale formations and receives irrigation return flows from Mancos-derived soils. Mining within the Tower mine plan area is expected to have no impact on this system.

The construction and upgrading of surface facilities utilized in conjunction with the Centennial Project (yard areas, roads, conveyor lines, etc.) will result in temporary increases in the suspended sediment concentration of the adjacent stream. However, because of the regulatory requirement that sediment control be provided for all areas of surface disturbance, concentrations should be quickly normalized.

3.6 Mitigation and Control Plans

Runoff from all disturbed areas will be passed through sediment control facilities, as discussed earlier in this report. Any discharge from facilities will be monitored in accordance with NPDES permit standards and state and federal regulations.

The effects of the mining operation on the surface water system will be analyzed through the surface water monitoring plan described in the next section. In the unlikely event that monitoring shows that the surface water system is being adversely affected by the mining activities, additional steps will be taken to rectify the situation in consultation with State and Federal agencies.

3.7 Surface Water Monitoring Plan

An ongoing hydrologic monitoring program will be conducted at each of the stations shown on Figure 6. Stations 7-1 and 18-4 (located above and below the disturbed area in the Right Fork of Deadman Canyon) will be used as indicators of the effect of surface disturbances in the canyon on water quality. Stations 8-1 and 17-1 (located above and below the proposed surface facilities in the small drainage basin just east of the Right Fork of Deadman Canyon) will be used as indicators of the effect of surface disturbances in that canyon on water quality. Portals may also be constructed in the future in Straight Canyon. If so, Stations 8-1 and 17-2 will be established above and below the area of surface disturbance two years prior to the commencement of construction. As mentioned previously, all of these streams are ephemeral and will consequently not have water to be sampled most of the time.

Samples will be collected monthly during the 1981 baseline period when accessible and flowing from all surface water stations shown on Figure 6, and will be analyzed according to the schedule listed in Table 2. Samples will be analyzed according to

Attachment A. Beginning in 1982, after the baseline data has been gathered, the sampling frequency will be reduced to a quarterly basis.

Surface water monitoring will continue on a quarterly basis, when accessible, during post mining operations until the reclamation effort is approved by the regulatory agency. Post-mining samples will be analyzed in accordance with the water quality analytical schedule in Table 2 (or an abbreviated schedule approved by the appropriate regulating agencies).

In addition to the above outlined monitoring program, an NPDES discharge permit will be acquired as necessary for new surface facilities. Monitoring of all discharges will be conducted in accordance with these permits.

As required, water quality data collected from surface water monitoring stations will be submitted to the regulatory authority (Utah Division of Oil, Gas, and Mining). Such reports will normally be submitted within 60 to 90 days at the end of each quarter, depending upon the speed of the laboratory analyses.

4. ALLUVIAL VALLEY FLOOR DETERMINATION

The geomorphic criteria for identification of potential alluvial floors are not met within the Tower mine plan or adjacent areas within a two mile radius. Doelling (1972) did not identify any alluvial deposits within a two mile radius of the mine plan area. Consequently, no further investigations in regard to alluvial valley floors should be required.

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