Mill Fork Right-of-Way Application

PACIFICORP

ENERGY WEST Mining Co.

DEER CREEK MINE
MILL FORK ACCESS

Application for Transportation and Utility Systems and Facilities

Underground Right-of-Way Application

November 2000

File in:
- ☐ Confidential
- ☐ Shelf
- ☒ Expandable

Refer to Record No 0050 Date 1/2/2001
In C/015/018, 2000, Incoming
For additional information

0050

ENERGY WEST Mining Co.
PO Box 310
Huntington, Utah 84528

COPY

November 21, 2000

Mr. Richard Manus, Field Manager
Bureau of Land Management
Price Office Field Office
P.O. Box 7004
125 South 600 West
Price, Utah 84501

Dear Mr. Manus:

PacifiCorp, by and through its wholly-owned subsidiary, Energy West Mining Company ("Energy West") as mine operator, hereby submits an Special-Use Application and Report (FS2700-3) for an underground right-of-way through un-leased federal coal between existing Federal Coal Lease U-06039 and Utah State Institutional Trust Lands Administration Lease Number ML-48258 located in Emery County, Utah. As discussed in our meeting on September 27, 2000, the Bureau of Land Management - Price Field Office will be the "lead agency" and will coordinate with the surface management agency: United States Forest Service.

As stated in the meeting, PacifiCorp has conducted extensive geologic/hydrologic research in the right fork of Rilda Canyon, including drilling twelve (12) surface exploration holes, numerous underground exploration holes, and performing three (3) geophysical surveys. This data has been utilized by PacifiCorp to developed comprehensive model and confirms underground access to the Mill Fork Lease through un-leased federal coal is viable. Investigations also revealed no evidence of structural discontinuities (Mill Fork Graben) throughout the Right Fork of Rilda Canyon (refer to attached Drawing # DS1633E: Deer Creek Mine Right Fork of Rilda Canyon Geologic Cross Section). The enclosed application includes the requested information:

- Bureau of Land Management: Application for Transportation and Utility Systems and Facilities on Federal Lands (Form 299)
- United States Forest Service:Special-Use Application and Report (Form 2700-3)
- Underground Right-of-Way Mining Plan (Drawing # CM-10905-DR)

In addition, PacifiCorp has included a coal seam isopach map (Hiawatha seam) for the Mill Fork Right-of-Way Application area. The isopach map is based upon exploration drilling completed by PacifiCorp and data obtained from the BLM Salt Lake Office.

Huntington Office:
(435) 687-9821
Fax (435) 687-2695
Purchasing Fax (435) 687-9092

Deer Creek Mine:
(435) 687-2317
Fax (435) 687-2285

Trail Mountain Mine:
(435) 748-2140
Fax (435) 748-5125

COPY

If there are any questions or concerns please call Chuck Semborski at (435) 687-4720 or Scott Child (801) 220-4610.

Sincerely,

Carl Pollastro
Manager of Technical Services

Enclosures

cc: Elaine Zeroth (U.S.F.S. - Price Office), with enclosures (3 copies)
John Blake (SITLA), with enclosures
Mary Ann Wright (DOGM), with enclosures
Chuck Semborski, with enclosures
Scott Child (Interwest), with enclosures
File: Deer Creek 2000: Mill Fork Right-ofWay Application

BLMCoverLetter.wpd

Mill Fork Right-of-Way Application

PACIFICORP

ENERGY WEST Mining Co.

DEER CREEK MINE
MILL FORK ACCESS

Enclosed Information

Form 299: Application for Transportation and Utility Systems and Facilities on Federal Lands

Form 2700-3: Underground Right-of-Way Application and Report

Drawing # CM-10905
Deer Creek Mine
Underground Right-of-Way
Mining Plan

Analysis of Long Term Entry Stability and the Potential for Surface Influence of Entry Development Outside the Current Lease Boundary of Federal Lease U-06039, November 2000

November 2000

Mill Fork Right-of-Way Application

PacifiCorp

Energy West Mining Co.

DEER CREEK MINE
MILL FORK ACCESS

Form 299: Application for Transportation and Utility Systems and Facilities on Federal Lands

November 2000

STANDARD FORM 299 (1/99)
Prescribed by DOI/USDA/DOT
P.L. 96-487 and Federal
Register Notice 5-22-95

APPLICATION FOR TRANSPORTATION AND UTILITY SYSTEMS AND FACILITIES ON FEDERAL LANDS

FORM APPROVED
OMB NO. 1004-0060
Expires: December 31, 2001

FOR AGENCY USE ONLY

NOTE: Before completing and filing the application, the applicant should completely review this package and schedule a preapplication meeting with representatives of the agency responsible for processing the application. Each agency may have specific and unique requirements to be met in preparing and processing the application. Many times, with the help of the agency representative, the application can be completed at the preapplication meeting.

Application Number

Date Filed

1. Name and address of applicant *(include zip code)*
PacifiCorp
C/O InterWest Mining Company
Scott Child, Property Management Administrator
One Utah Center 2000
201 South Main Street
Salt Lake City, Utah 84140

2. Name, title, and address of authorized agent if different from item 1 *(include zip code)*
Energy West Mining Company
Charles A. Semborski,
Geology/Permitting Supervisor
P.O. Box 310
Huntington, Utah 84528

3. TELEPHONE *(area code)*

Applicant
Scott Child (801) 220-4612

Authorized Agent
Charles Semborski (435) 687-4720

4. As applicant are you? *(check one)*
a. ☐ Individual
b. x Corporation*
c. ☐ Partnership/Association*
d. ☐ State Government/State Agency
e. ☐ Local Government
f. ☐ Federal Agency

** If checked, complete supplemental page*

5. Specify what application is for: *(check one)*
a. X New authorization
b. ☐ Renewing existing authorization No.
c. ☐ Amend existing authorization No.
d. ☐ Assign existing authorization No.
e. ☐ Existing use for which no authorization has been received *
f. ☐ Other*

** If checked, provide details under item 7*

6. If an individual, or partnership are you a citizen(s) of the United States? ☐ yes ☐ No

7. Project description (describe in detail): (a) Type of system or facility, *(e.g., canal, pipeline, road);* (b) related structures and facilities; (c) physical specifications *(Length, width, grading, etc.)*; (d) term of years needed: (e) time of year of use or operation; (f) Volume or amount of product to be transported; (g) duration and timing of construction; and (h) temporary work areas needed for construction *(Attach additional sheets, if additional space is needed.)*

See Attached Supplemental Information – Item No. 7

8. Attach a map covering area and show location of project proposal See Attached Supplemental Information Item No. 8 and Map No. 1

9. State or Local government approval: ☐ Attached ☐ Applied for ☐ Not Required Right-of-Way will be included in the Deer Creek Mine Permit Package

10. Nonreturnable application fee: X Attached ☐ Not required

11. Does project cross international boundary or affect international waterways? ☐ Yes X No *(If "yes," indicate on map)*

12. Give statement of your technical and financial capability to construct, operate, maintain, and terminate system for which authorization is being requested.

See Attached Supplemental Information – Item No. 12

13a. Describe other reasonable alternative routes and modes considered.

See Attached Supplemental Information – Item No. 13

b. Why were these alternatives not selected?

See Attached Supplemental Information – Item No. 13

c. Give explanation as to why it is necessary to cross Federal Lands.

See Attached Supplemental Information – Item No. 13

14. List authorizations and pending applications filed for similar projects which may provide information to the authorizing agency. *(Specify number, date, code, or name)*

See Attached Supplemental Information – Item No. 14

15. Provide statement of need for project, including the economic feasibility and items such as: (a) cost of proposal (construction, operation, and maintenance); (b) estimated cost of next best alternative; and (c) expected public benefits.

See Attached Supplemental Information – Item No. 15

16. Describe probable effects on the population in the area, including the social and economic aspects, and the rural lifestyles.

See Attached Supplemental Information – Item No. 16

17. Describe likely environmental effects that the proposed project will have on: (a) air quality; (b) visual impact; (c) surface and ground water quality and quantity; (d) the control or structural change on any stream or other body of water; (e) existing noise levels; and (f) the surface of the land, including vegetation, permafrost, soil, and soil stability.

See Attached Supplemental Information – Item No. 17

18. Describe the probable effects that the proposed project will have on (a) populations of fish, plantlife, wildlife, and marine life, including threatened and endangered species; and (b) marine mammals, including hunting, capturing, collecting, or killing these animals.

See Attached Supplemental Information – Item No. 18

19. State whether any hazardous material, as defined in this paragraph, will be used, produced, transported or stored on or within the right-of-way or any of the right-of-way facilities, or used in the construction, operation, maintenance or termination of the right-of-way or any of its facilities. "Hazardous material" means any substance, pollutant or contaminant that is listed as hazardous under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, 42 U.S.C. 9601 et seq., and its regulations. The definition of hazardous substances under CERCLA includes any "hazardous waste" as defined in the Resource Conservation and Recovery Act of 1976 (RCRA), as amended, 42 U.S.C. 6901 et seq., and its regulations. The term hazardous materials also includes any nuclear or byproduct material as defined by the Atomic Energy Act of 1954, as amended, 42 U.S.C. 2011 et seq. The term does not include petroleum, including crude oil or any fraction thereof that is not otherwise specifically listed or designated as a hazardous substance under CERCIA Section 101(14), 42 U.S.C. 9601(14), nor does the term include natural gas.

See Attached Supplemental Information – Item No. 19

20. Name all the Department(s)/Agency(ies) where this application is being filed.

See Attached Supplemental Information – Item No. 20

I HEREBY CERTIFY, That I am of legal age and authorized to do business in the State and that I have personally examined the information contained in the application and believe that the information submitted is correct to the best of my knowledge.

Signature of Applicant	Date

Title 18, U.S.C. Section 1001, makes it a crime for any person knowingly and willfully to make to any department or agency of the United States any false, fictitious, or fraudulent statements or representations as to any matter within its jurisdiction.

SUPPLEMENTAL

NOTE: The responsible agency(ies) will provide instructions	CHECK APPROPRIATE BLOCK	
I - PRIVATE CORPORATIONS	ATTACHED	FILED*
a. Articles of Incorporation	❑	X
b. Corporation Bylaws	❑	X
c. A certification from the State showing the corporation is in good standing and is entitled to operate within the State	❑	X
c. Copy of resolution authorizing filing	❑	X
e. The name and address of each shareholder owning 3 percent or more of the shares, together with the number and percentage of any class of voting shares of the entity which such shareholder is authorized to vote and the name and address of each affiliate of the entity together with, in the case of an affiliate controlled by the entity, the number of shares and the percentage of any class of voting stock of that affiliate owned, directly or indirectly, by that entity, and in the case of an affiliate which controls that entity, the number of shares and the percentage of any class of voting stock of that entity owned, directly or indirectly, by the affiliate.	❑	X
f. If application is for an oil or gas pipeline, describe any related right-of-way or temporary use permit applications, and identify previous applications.	❑	❑
g. If application is for an oil and gas pipeline, identify all Federal lands by agency impacted by proposal.	❑	❑
II - PUBLIC CORPORATIONS		
a. Copy of law forming corporation	❑	❑
b. Proof of organization	❑	❑
c. Copy of Bylaws	❑	❑
d. Copy of resolution authorizing filing	❑	❑
e. If application is for an oil or gas pipeline, provide information required by item "I-f" and "I-g" above.	❑	❑
III - PARTNERSHIP OR OTHER UNINCORPORATED ENTITY		
a. Articles of association, if any	❑	❑
b. If one partner is authorized to sign, resolution authorizing action is	❑	❑
c. Name and address of each participant, partner, association, or other	❑	❑
d. If application is for an oil or gas pipeline, provide information required by item "I-f" and "I-g" above.	❑	❑

* If the required information is already filed with the agency processing this application and is current, check block entitled "Filed." Provide the file identification information *(e.g., number, date, code, name)*. If not on file or current, attach the requested information.

DATA COLLECTION STATEMENT

The Federal agencies collect this information from applicants requesting right-of-way, permit, license, lease, or certifications for the use of Federal lands

Federal agencies use this information to evaluate your proposal

No Federal agency may request or sponsor, and you are not required to respond to a request for information which does not contain a currently valid OMB Approval Number.

BURDEN HOURS STATEMENT

The public burden for this form is estimated to vary from 30 minutes to 25 hours per response, with an average of 2 hours per response, including the time for reviewing instructions, gathering and maintaining data, and completing and reviewing the form. Direct comments regarding the burden estimate or any other aspect of this form to: U.S. Department of the Interior, Bureau of Land Management, Information Clearance Officer (WO-630), 1849 C Street, Mail Stop 401LS, Washington, D.C. 20240

A reproducible copy of this form may be obtained from the Bureau of Land Management, Division of Lands, 1620 L Street, Rm. 1000LS, Washington, D.C. 20036

GENERAL INFORMATION
ALASKA NATIONAL INTEREST LANDS

This application will be used when applying for a right-of-way, permit, license, lease, or certificate for the use of Federal lands which lie within conservation system units and National Recreation or Conservation Areas as defined in the Alaska National Interest lands Conservation Act. Conservation system units include the National Park System, National Wildlife Refuge System, National Wild and Scenic Rivers System, National Trails System, National Wilderness Preservation System, and National Forest Monuments.

Transportation and utility systems and facility uses for which the application may be used are:

1. Canals, ditches, flumes, laterals, pipes, pipelines, tunnels, and other systems for the transportation of water.
2. Pipelines and other systems for the transportation of liquids other than water, including oil, natural gas, synthetic liquid and gaseous fuels, and any refined product produced therefrom.
3. Pipelines, slurry and emulsion systems, and conveyor belts for transportation of solid materials.
4. Systems for the transmission and distribution of electric energy.
5. Systems for transmission or reception of radio, television, telephone, telegraph, and other electronic signals, and other means of communications.
6. Improved right-of-way for snow machines, air cushion vehicles, and all-terrain vehicles.
7. Roads, highways, railroads, tunnels, tramways, airports, landing strips, docks, and other systems of general transportation.

This application **must** be filed simultaneously with each Federal department or agency requiring authorization to establish and operate your proposal.

In Alaska, the following agencies will help the applicant file an application and identify the other agencies the applicant should contact and possibly file with:

Department of Agriculture
Regional Forester, Forest Service (USFS)
Federal Office Building,
P.O. Box 21628
Juneau, Alaska 99802-1628
Telephone: (907) 586-7847 *(or a local Forest Service Office)*

Department of the Interior
Bureau of Indian Affairs (BIA)
Juneau Area Office
Federal Building Annex
9109 Mendenhall Mall Road, Suite 5
Juneau, Alaska 99802
Telephone: (907) 586-7177

Department of the Interior
Bureau of Land Management
222 West 7th Avenue
P.O. Box 13
Anchorage, Alaska 99513-7599
Telephone: (907) 271-5477 (or a local BLM Office)

National Park Service (NPS)
Alaska Regional Office
2525 Gambell Street, Room 107
Anchorage, Alaska 99503-2892
Telephone: (907) 257-2585

U.S. Fish & Wildlife Service (FWS)
Office of the Regional Director
1011 East Tudor Road
Anchorage, Alaska 99503
Telephone: (907 786-3440

Note-Filings with any Interior agency may be filed with any office noted above or with the: Office of the Secretary of the Interior, Regional Environmental Officer, Box 120, 1675 C Street, Anchorage, Alasaka 99513

(For supplemental, see reverse)

Department of Transportation
Federal Aviation Administration
Alaska Region AAL-4, 222 West 7th Ave., Box 14
Anchorage, Alaska 99513-7587
Telephone: (907) 271-5285

NOTE - The Department of Transportation has established the above central filing point for agencies within that Department. Affected agencies are: Federal Aviation Administration (FAA), Coast Guard (USCG), Federal Highway Administration (FHWA), Federal Railroad Administration (FRA).

OTHER THAN ALASKA NATIONAL INTEREST LANDS

Use of this form is not limited to National Interest Conservation Lands of Alaska.

Individual department/agencies may authorize the use of this form by applicants for transportation and utility systems and facilities on other Federal lands outside those areas described above.

For proposals located outside of Alaska, applications will be filed at the local agency office or at a location specified by the responsible Federal agency.

SPECIFIC INSTRUCTIONS
(Items not listed are self-explanatory)

Item

7 Attach preliminary site and facility construction plans. The responsible agency will provide instructions whenever specific plans are required.

8 Generally, the map **must** show the section(s), township(s), and range(s) within which the project is to be located. Show the proposed location of the project on the map as accurately as possible. Some agencies require detailed survey maps. The responsible agency will provide additional instructions.

9 10, and 12 - The responsible agency will provide additional instructions.

13 Providing information on alternate routes and modes in as much detail as possible, discussing why certain routes or modes were rejected and why it is necessary to cross Federal lands will assist the agency(ies) in processing your application and reaching a final decision. Include only reasonable alternate routes and modes as related to current technology and economics.

14 The responsible agency will provide instructions.

15 Generally, a simple statement of the purpose of the proposal will be sufficient. However, major proposals located in critical or sensitive areas may require a full analysis with additional specific information. The responsible agency will provide additional instructions.

16 through 19 - Providing this information is as much detail as possible will assist the Federal agency(ies) in processing the application and reaching a decision. When completing these items, you should use a sound judgment in furnishing relevant information. Fore example, if the project is not near a stream or other body of water, **do not** address this subject. The responsible agency will provide additional instructions.

Application **must** be signed by the applicant or applicant's authorized representative.

If additional space is needed to complete any item, please put the information on a separate sheet of paper and identify it as "Continuation of Item".

NOTICE

NOTE: This applies to the Department of the Interior/Bureau of Land Management (BLM).

The Privacy Act of 1974 provides that you be furnished with the following information in connection with the information provided by this application for an authorization.

AUTHORITY: 16 U.S.C. 310 and 5 U.S.C. 301.

PRINCIPAL PURPOSE: The primary uses of the records are to facilitate the (1) processing of claims or applications; (2) recordation of adjudicative actions; and (3) indexing of documentation in case files supporting administrative actions.

ROUTINE USES: BLM and the Department of the Interior (DOI) may disclose your information on this form: (1) to appropriate Federal agencies when concurrence or supporting information is required prior to granting or acquiring a right or interest in lands or resources; (2) to members or the public who have a need for the information that is maintained by BLM for public record; (3) to the U.S. Department of Justice, court, or other adjudicative body when DOI determines the information is necessary and relevant to litigation; (4) to appropriate Federal, State, local, or foreign agencies responsible for investigating, persecuting violation, enforcing, or implementing this statute, regulation, or order; and (5) to a congressional office when you request the assistance of the Member of Congress in writing.

EFFECT OF NOT PROVIDING THE INFORMATION: Disclosing this information is

necessary to receive or maintain a benefit. Not disclosing it may result in rejecting the application.

Bureau of Land Management
Application for Transportation and Utility Systems and Facilities
Deer Creek Mine
Mill Fork State Coal Lease ML-48258 Access
November 2000

PART 1 - ITEM 7

7. a. Type of use:

To allow underground mine development in small portions of unleased federal coal located outside of the federal coal lease boundaries of U-06039, in support of underground access from the Deer Creek Mine to Mill Fork State Coal Lease ML-48258. The underground right-of-way access will consist of a six (6) entry mains (designated as MFA) from the 5th North Mains in Federal Coal Lease U-06039 to the southern boundary of State Coal Lease ML-48258. The Mill Fork Access (MFA) mains will be located within the Hiawatha coal seam approximately 600 to over 2000 feet below the surface of East Mountain (see Map 1 for proposed entry developments). Each entry will be approximately 20 feet wide by 8 feet high. (Refer to *Analysis of Long Term Entry Stability and the Potential for Surface Influence of Entry Development Outside the Current Lease Boundary of Federal Lease U-06039* prepared by Energy West Mining Company dated November 2000.) Activities associated with the development of the underground rights-of-way include cutting, removing, loading and transporting of coal from the right-of-way areas in conjunction with other coal production from the Deer Creek Mine.

b. Related structures and facilities:

There are no surface structures or facilities associated with the proposed underground right-of-way.

c. Physical specifications:

The proposed underground right-of-way will consist of a six (6) entry set of mains located in Section 19, Township 16 South, Range 7 East and Section 24, Township 16 South, Range 6 East, S.L.B.& M.. Depending on geologic and engineering conditions, the proposed six (6) entry system will be developed and situated within the legal subdivisions as described in PART 1 - ITEM 8 of this application. See Map 1 for the proposed underground development entries, location, size and dimensions.

d. Term of years needed: 20 years.

e. Time of year of use or operation: Year-round use.

f. Volume or amount of product to be transported:

The underground right-of-way will serve as the ventilation and transportation connection between the existing Deer Creek Mine underground workings located in Federal Coal U-06039 and the Mill Fork State Coal Lease ML-48258 coal reserves. The access will consist

of a six entry main development with three entries for intake, two for return air and one beltline. Annual coal haulage is estimated at approximately 4.5 million tons per year.

g. Duration and timing of construction:

Development of the approximately six thousand (6,000) feet of six (6) entry mains will require approximately eleven (11) months of mining (western boundary of Federal Coal Lease U-06039 to the southeast boundary of State Coal Lease ML-48258). Mining in the right-of-way area will commence simultaneously with the extraction of the Hiawatha seam within Federal Coal Lease U-06039 scheduled for November 2002.

h. Temporary work areas needed for construction:

No temporary work areas are needed for the construction of this underground right-of-way. Access is provided from existing permitted mine operations.

PART 1 - ITEM 8

8. Attach map covering area and show location of proposed use and/or furnish legal description of the land:

The underground rights-of-way areas as described below include approximately 245.61 acres as defined by the legal subdivisions. However, it is anticipated that the underground right-of-way entries (as proposed) will include approximately 47.4 acres of actual mine developed areas situated within the following:

T. 16 S., R. 7 E., S.L.B.& M.

Section 19	Lot 3	22.83 acres
	Lot 4	22.78 acres

T. 16 S., R. 6 E., S.L.B.& M.

Section 24	N1/2 SW1/4	80 acres
	N1/2 SE1/4	80 acres
	N1/2 S1/2 SE1/4	40 acres
Total		245.61 acres

See Map 1 for location and details.

PART 1 - ITEM 12

12. Statement of technical and financial capability to construct, operate and terminate the use for which authorization is requested, including the protection and restoration of federal lands:

PacifiCorp, an Oregon corporation wholly-owned by Scottish Power, is a diversified electric utility company serving 1.5 million retail customers in western United States (third largest electric utility west of the Rocky Mountains). Scottish Power is an investor-owned entity with PacifiCorp representing assets of $1,742.2 million with annual revenues of $4,899.6 million.

Interwest Mining Co. & Energy West Mining Co. are both wholly-owned subsidiaries of PacifiCorp.Interwest Mining Co. is PacifiCorp's managing agent, and Energy West Mining Co. is the mine operator of its Deer Creek, Cottonwood, Des-Bee-Dove and Trail Mountain mines. PacifiCorp, through its predecessor, Utah Power & Light Co., has owned and operated the mines in the local vicinity for nearly 30 years.

All equipment, personnel and technical expertise are currently in place at the Deer Creek Mine to develop these underground entries in the right-of-way areas. The underground right-of-way will be constructed, maintained, operated and terminated in accordance with all applicable state, federal and local regulations.

PART 1 - ITEM 13

a. Describe other reasonable alternative proposals considered:

A variety of alternatives were evaluated in order to access State Coal Lease ML-48258. An underground access corridor from Federal Coal Lease U-06039 to State Coal Lease ML-48258 minimizes environmental disturbance and maximizes resource recovery. PacifiCorp has considered (1) a lease modification, (2) emergency leasing, and (3) underground right-of-way. In discussions with the USFS and BLM, the underground right-of-way appears to be the most simplistic and correct mechanism to achieve the desired results for all parties.

b. Why were these alternatives not selected?

A lease modification would essentially serve the same purpose, but the intent with this application is to minimize mine development in these areas to eventually maximize the recovery in ML-48258. A lease modification is acreage restricted. Emergency leasing is a viable option, however, the timing process would also hinder overall production planning and coal delivery requirements.

The underground rights-of-way provides the better of the alternatives simply because it (1) does not create any new surface disturbance, (2) it allows use of the Deer Creek Mine existing

infrastructure for coal haulage, processing, loading and unloading of coal, (3) visual impacts remain unchanged, and (4) the timing to permit and acquire said rights-of-way appears to be more conducive to development and production criteria.

c. Give explanation of why it is necessary to cross Federal Lands.

In addition to the comments in Part 1 Item 13 a. (above) it is necessary to utilize federal lands because of the dominance of federal lands in the area. It is imperative to use adjacent lands to federal coal lease U-06039, as there is no other choice. This is crucial to the development and maximum economic recovery of coal reserves in ML-48258.

PART 1 - ITEM 14

List authorizations and pending applications filed for similar projects which may provide information to the authorizing agent.

PacifiCorp submitted and received approval for an underground right-of-way from the United States Forest Service for the Trail Mountain Mine. In conjunction with the right-of-way application, PacifiCorp applied for and received approval for lease modification for Federal Coal Lease UTU-64375.

No others projects are currently pending.

PART 1 - ITEM 15

Provide statement of need for proposed use, including the economic feasibility and items such as:

PacifiCorp has a significant investment in the acquisition of the Mill Fork Lease ML-48258 reserves. This acquisition was predicated by the need to acquire additional reserves to provide a continual and reliable long term fuel supply for the Huntington Power Plant. Therefore, PacifiCorp recommends that this application for the requested underground right-of-way be granted to accomplish an effective access to State Coal Lease ML-48258. This alternative mine plan further compliments the purpose of extending the coal reserve base.

a. Cost of proposal (construction, operation and maintenance):

In the spirit of what this application is intended for, the costs of developing the entries in the right-of-way areas will hopefully be offset by the long range benefits of increased longwall coal recovery. This of course, is a risk to the applicant with none to the public. In return, this would provide additional royalties to the public which would not otherwise be realized. These portions of the existing reserves would not otherwise be mined since the reserves fall outside of the existing federal and state coal lease boundaries.

b. Estimated cost of next best alternative:

No other alternatives were considered due to timeliness and potential lost production.

c. Expected public benefits:

PacifiCorp as owner of the mine and power plant employs approximately 900 people in the local area which is a significant factor in providing some stability to the socioeconomics in the area. In addition, the granting of the underground right-of-way will encourage (1) the greatest ultimate use of a public resource, (2) maximization of coal recovery with no anticipated impacts, and (3) additional royalty revenue to the public.

PART 1 - ITEM 16

Describe probable effects on the area population, including social and economic aspects and rural lifestyle:

It is not anticipated that there would be any effects to the area population nor would it have any effect on the social and economic aspects. Depending upon the disposition of this application, it will either increase or decrease the mine life.

PART 1 - ITEM 17

Describe likely environmental effects that the proposed use will have on:

a. Air quality: None

b. Visual impact: None

c. Surface and ground water quality and quantity: None (PacifiCorp proposes first mining/no subsidence mining within the right-of-way).

d. Control or structural change on any stream or other body of water: There will be no control or structural change to any stream or body of water as a result of this underground mine access.

e. Existing noise levels: No additional noise will be created by the right-of-way.

f. Land surface, including vegetation, permafrost, soil and soil stability: None anticipated - refer to attached reports.

g. **Populations of fish, plant, wildlife and marine life, including threatened and endangered species:** None.

PART 1 - ITEM 18

Describe the probable effects that the project will have on (a) populations of fish, plantlife, wildlife, and marine life, including threatened and endangered species; and (b) marine mammals, including hunting, capturing, collecting, or killing these animals.

The right-of-way will have no effect on the surface. The underground mine entries and pillars will be designed and constructed in accordance with the best available technology, engineering practices and historical experience to eliminate surface subsidence. No pillar extraction or second mining will occur in the right-of-way areas.

PART 1 - ITEM 19

State, whether any hazardous material, as defined in this paragraph, will be used produced, transported or stored on within the right-of-way or any of the right-of-way facilities, or used in the conjunction, operation, maintenance or termination of the right-of-way or any of its facilities. "Hazardous material" means any substance, pollutant or contaminant that is listed as hazardous under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, 42 U.S.C. 9601 et seq., and its regulations. The definition of hazardous substances under CERCLA includes any "hazardous waste" as defined in the Resource Conservation and Recovery Act of 1976 (RCRA), as amended, 42 U.S.C. 9601 et seq., and its regulations. The term hazardous materials also includes any nuclear or byproduct material as defined by the Atomic Energy Act of 1954, as amended, 42 U.S.C. 2011 et seq. The term does not include petroleum, including crude oil or any fraction thereof that is not otherwise specifically listed or designated as a hazardous substance under CERCLA Section 101(14), nor does the term include natural gas.

PacifiCorp will comply with Special Stipulations attached to the adjacent Federal Coal Lease U-06039:

Section 15. Special Stipulations

24. WASTE CERTIFICATION: The lessee shall provide upon abandonment and or/sealing off a mined area and prior to lease termination/relinquishment, certification to the lessor that, based upon a complete search of all the operator's records for the mine and upon their knowledge of past operations, there has been no **hazardous substances** per (40 CFR 302.4) or **used oil** as per Utah State Management Rule R-315-15, deposited within the lease *(right-of-*

way), either on the surface or underground, or that all remedial action necessary has been taken to protect human health and the environment with respect to any such substances remaining on the property. The backup documentation to be provided shall be described by the lessor prior to the first certification and shall include all documentation applicable to the Emergency Planning and Community Right-to-Know Act (EPCRA, Public Law 99-499), Title III of the Superfund Amendments and Re-authorization Act of 1986 or equivalent.

25. UNDERGROUND INSPECTION: All safe and accessible areas shall be inspected prior to being sealed. The lessee shall notify the Authorized Officer in writing 30 days prior to the sealing of any areas in the mine and state the reason for closure. Prior to seals being put in place, the lessee shall inspect the area and document any equipment/machinery, hazardous substances, and used oil that is to be left underground. The Authorized Officer may participate in this inspection. The purpose of this inspection will be: (1) to provide documentation for compliance with 42 U.S.C. 9620 section 120(h) and State Management Rule R-315-15, and to assure that certification will be meaningful at the time of lease relinquishment, (2) to document the inspection with a mine map showing location of equipment/machinery (model, type of fluid, amount remaining, batteries etc.) that is proposed to be left underground. In addition, these items will be photographed at the lessee's expense and shall be submitted to the Authorized Officer as part of the certification. The abandonment of any equipment/machinery shall be on a case by case basis and shall not be accomplished unless the Authorized Officer has granted a written approval. Any on-lease *(right-of-way)* disposal of non-coal waste must comply with 30 CFR § 817.89.

PART 1 - ITEM 20

Name all Federal, State, County or other department(s) / agency(ies) where an application for this is being filed. Attach appropriate license, building permit, certificate or other approval document:

United States Forest Service
Manti-LaSal National Forest
599 West Price River Drive
Price, Utah 84501

U.S. Department of the Interior
Bureau of Land Management
Utah State Office
324 South State Street, Suite 301
Salt Lake City, Utah 84111-2303

U.S. Department of the Interior
Bureau of Land Management
Price Field Office
125 South 600 West
Price, Utah 84501

State of Utah
Division of Oil, Gas & Mining
1594 West North Temple, Suite 1210
Box 145801
Salt Lake City, UT 84114-5801

State of Utah
School and Institutional Trust Lands Administration
675 East 500 South, Suite 500
Salt Lake City, Utah 84102

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Mill Fork Right-of-Way Application

PACIFICORP

ENERGY WEST Mining Co.

DEER CREEK MINE
MILL FORK ACCESS

Form 2700-3: Underground Right-of-Way Application and Report

November 2000

USDA - Forest Service PacifiCorp/Interwest Mining Co.: Deer Creek/Mill Fork Access FS-2700-3 (10/96) OMB No. 0596-0082

FOREST SERVICE USE ONLY

SPECIAL-USE APPLICATION AND REPORT (REF.: FSM 2712, 36 CFR 251.54) INSTRUCTIONS Applicant should request a meeting with the Forest Service representative responsible for processing the application, prior to completing this form. This meeting will allow a discussion of the form's requirements and identify those items to be omitted.	Date Received (mm/dd/yyyy)	Region Number	State Code	County Code
	Congressional Dist. Number	Forest Code (Admin. Unit No.)	Unit ID Symbol (NFFID No.)	
	Ranger Dist. No. (Resp. Dist.)	User Number	Kind of Use Code	

◆ **PART 1--APPLICATION (Applicant Completes)**

1. Applicant Name and Address	2. Authorized Agent Name, Title and Address (include Zip Code) if different from Item 1.	3. Area Code and Telephone No.
PacifiCorp C/O InterWest Mining Co. Scott Child, Property Management Administrator One Utah Center 2000 201 South Main Street Salt Lake City, Utah 84140	Energy West Mining Company Charles A. Semborski, Geology/Permitting. P.O. Box 310 Huntington, Utah 84528	a. Applicant's (801)-220-4612 b. Authorized Agent's (435)-687-4720

4. As applicant are you? (Mark one box with "X")
   - a. [ ] Individual
   - b. [X] Corporation*
   - c. [ ] Partnership/Association*
   - d. [ ] State Government/State Agency
   - e. [ ] Local Government
   - f. [ ] Federal Agency

   * If marked "X", complete PART II.

5. Specify what application is for: (Mark one box with "X")
   - a. [X] New authorization*
   - b. [ ] Renew existing authorization
   - c. [ ] Amend existing authorization*
   - d. [ ] Other*

   * If marked "X", provide details under Item 7

6. If you are an individual or partnership, are you also a citizen(s) of the United States? N/A
   [ ] Yes [ ] No

7. Describe in detail the land use, including: (a) type of use, activity, or facility; (b) related structures and facilities; (c) physical specifications (length, width, acres, etc.); (d) term of years needed; (e) time of year of use or operation; (f) duration and timing of construction; (g) temporary work areas needed for construction; and (h) anticipated need for future expansion. (If extra space is needed, use Page 3, REMARKS).

See Attached Supplemental Information - Item No. 7

8. Attach map covering area and show location of proposed use and/or furnish legal description of the land.

See Attached Map 1

9. Give statement of your technical and financial capability to construct, operate, and terminate the use for which authorization is requested, including the protection and restoration of Federal lands. (If extra space is needed, use page 3, REMARKS).

See Attached Supplemental Information - Item No. 9

10a. Describe other reasonable alternative proposals considered.

See Attached Supplemental Information - Item No. 10a

10b. Give explanation of why it is necessary to utilize Federal lands and why the alternative in Item 10a were not selected.

See Attached Supplemental Information - Item No. 10b

11. Provide statement of need for proposed use, including the economic feasibility and items such as: (a) cost of proposal (construction, operation, and maintenance); (b) estimated cost of next best alternative; and (c) expected public benefits. (If extra space is needed, use page 3, REMARKS).

See Attached Supplemental Information - Item No. 11

12. Describe probable effects on the area population, including social and economic aspects, and rural lifestyles.

See Attached Supplemental Information - Item No. 12

13. Describe likely environmental effects that the proposed use will have on: (a) air quality; (b) visual impact; (c) surface and ground water quality and quantity; (d) control or structural change on any stream or other body of water; (e) existing noise levels; (f) land surface, including vegetation, permafrost, soil and soil stability; and (g) populations of fish, plant, wildlife and marine life, including threatened and endangered species. (If extra space is needed, use page 3, REMARKS).

See Attached Supplemental Information - Item No. 13

14. Describe what actions will be taken to protect the environment from the effects of the proposed use.

See Attached Supplemental Information - Item No. 14

15. Name all Federal, State, County or other department(s)/agency(ies) where an application for this is being filed. Attach appropriate license, building permit, certificate or other document.

See Attached Supplemental Information - Item No. 15

I HEREBY CERTIFY, that I am of legal age and authorized to do business in the State and that I have personally examined the information contained in the application and that this information is correct to the best of my knowledge.

16a. Applicant's Signature (Sign in Ink)	16b. Date

Title 18, U.S.C. Section 1001, makes it a crime for any person knowingly and willfully to make to any department or agency of the United States any false, fictitious, or fraudulent statements or representations as to any matter within its jurisdiction.

◆ PART II--SUPPLEMENTAL INFORMATION (Applicant Completes)

	MARK "X" IN APPROPRIATE BOX BELOW	
I--PRIVATE CORPORATIONS	ATTACHED	FILED*
a. Articles of Incorporation	[ ]	[X]
b. Corporation Bylaws	[ ]	[X]
c. A certification from the State showing the corporation is in good standing and is entitled to operate within the State.	[ ]	[X]
d. Copy of resolution authorizing filing.	[ ]	[X]
e. The name and address of each shareholder owning 3 percent or more of the shares, together with the number and percentage of any class of voting shares of the entity which such shareholder is authorized to vote and the name and address of each affiliate of the entity together with, in the case of an affiliate controlled by the entity, the number of shares and the percentage of any class of voting stock of that affiliate owned, directly or indirectly, by that entity, and in the case of an affiliate which controls that entity, the number of shares and the percentage of any class of voting stock of that entity owned, directly or indirectly, by the affiliate.	[ ]	[X]
f If application is for an oil or gas pipeline, describe any related right-of-way or temporary use permit applications, and identify previous applications	[ ] N/A	[ ]
g. If proposed land use involves other Federal lands identify each agency impacted by proposal.	[ ] N/A	[ ]
II - PUBLIC CORPORATIONS		
a. Copy of law forming corporation	[ ]	[ ]
b. Proof of organization	[ ]	[ ]
c. Copy of Bylaws	[ ]	[ ]
d. Copy of resolution authorizing filing	[ ]	[ ]
e. If application is for an oil or gas pipeline, provide information required by Item "I-f" and "I-g" above.	[ ]	[ ]
III--PARTNERSHIP OR OTHER UNINCORPORATED ENTITY		
a. Articles of association, if any.	[ ]	[ ]
b. If one partner is authorized to sign, resolution authorizing action is	[ ]	[ ]
c. Name and address of each participant, partner, association or other	[ ]	[ ]
d. If application is for an oil or gas pipeline, provide information required by Item "I-f" and "I-g" above.	[ ]	[ ]

* If the required information is already filed with the Forest Service and is current, check box titled "Filed." Provide the file identification information (e.g., number, date, code, name and office at which filed). If not on file or current, attach requested information.

Remarks: (This space is provided for more detailed responses to Part I.) Please indicate the item numbers to which these responses apply. Attach sheets, if additional space is needed.

See Attached Supplemental Information

◆ **PART III--REPORT ON APPLICATION (Forest Officer Completes)**

1. General description of the area and adaptability for the proposed use. Outline area on separate map if needed to clarify proposed use.

2. If previously under authorization indicate:

a. Name of Holder	b Date Authorized	c Date Closed

3. Describe any encumbrances on the land, such as withdrawals, power projects, easements, rights-of-way, mining claims, leases, etc. Show on map provided.

4. State approximate amount and kinds of timber to be cut, recommended stumpage prices, method of scaling; include recommendation on disposal of merchantable timber; (a) to holder at current damage appraisal or (b) to others than holder under regular timber sale procedure.

5a.	Will proposed use conform to Forest Land and Resource Management Plan?	[ ] Yes	[ ] No	
b.	Has an Environmental Assessment been prepared?	[ ] Yes (Attach)	[ ] No	
c.	Has an Environmental Impact Statement (P.L. 91-190, 42 USC 4321) been prepared?	[ ] Yes (Attach)	[ ] No	

(Note: If "No" is marked with an "X" in any of the above questions, explain in Item 6 below,)

6. Recommendations, including any factors which might effect the granting of the authorization or future use of the land.

Forest Service Special-Use
Underground Right-of-Way Application
Deer Creek Mine
Mill Fork State Coal Lease ML-48258 Access
November 2000

PART 1 - ITEM 7

7. a. Type of use:

To allow underground mine development in small portions of unleased federal coal located outside of the federal coal lease boundaries of U-06039, in support of underground access from the Deer Creek Mine to Mill Fork State Coal Lease ML-48258. The underground right-of-way access will consist of a six (6) entry mains (designated as MFA) from the 5th North Mains in Federal Coal Lease U-06039 to the southern boundary of State Coal Lease ML-48258. The Mill Fork Access (MFA) mains will be located within the Hiawatha coal seam approximately 600 to over 2000 feet below the surface of East Mountain (see Map 1 for proposed entry developments). Each entry will be approximately 20 feet wide by 8 feet high. (Refer to *Analysis of Long Term Entry Stability and the Potential for Surface Influence of Entry Development Outside the Current Lease Boundary of Federal Lease U-06039* prepared by Energy West Mining Company dated November 2000.) Activities associated with the development of the underground rights-of-way include cutting, removing, loading and transporting of coal from the right-of-way areas in conjunction with other coal production from the Deer Creek Mine.

b. Related structures and facilities:

There are no surface structures or facilities associated with the proposed underground right-of-way.

c. Physical specifications:

The proposed underground right-of-way will consist of a six (6) entry set of mains located in Section 19, Township 16 South, Range 7 East and Section 24, Township 16 South, Range 6 East, S.L.B.& M.. Depending on geologic and engineering conditions, the proposed six (6) entry system will be developed and situated within the legal subdivisions as described in PART 1 - ITEM 8 of this application. See Map 1 for the proposed underground development entries, location, size and dimensions.

d. Term of years needed: 20 years.

e. Time of year of use or operation: Year-round use.

f. Duration and timing of construction:

Development of the approximately six thousand (6,000) feet of six (6) entry mains will require approximately eleven (11) months of mining (western boundary of Federal Coal Lease U-06039 to the southeast boundary of State Coal Lease ML-48258). Mining in the right-of-way area will commence simultaneously with the extraction of the Hiawatha seam within Federal Coal Lease U-06039 scheduled for November 2002.

g. Temporary work areas needed for construction:

No temporary work areas are needed for the construction of this underground right-of-way. Access is provided from existing permitted mine operations.

h. Anticipated need for future expansion:

Barring any unknown adverse geologic conditions, it is not expected that there will be any need for future expansion. The area of the proposed underground rights-of-way as described above and as shown on Map 1, takes into consideration the areas needed for the underground entries.

PART 1 - ITEM 8

8. Attach map covering area and show location of proposed use and/or furnish legal description of the land:

The underground rights-of-way areas as described below include approximately 245.61 acres as defined by the legal subdivisions. However, it is anticipated that the underground right-of-way entries (as proposed) will include approximately 47.4 acres of actual mine developed areas situated within the following:

T. 16 S., R. 7 E., S.L.B.& M.

Section 19	Lot 3	22.83 acres
	Lot 4	22.78 acres

T. 16 S., R. 6 E., S.L.B.& M.

Section 24	N1/2 SW1/4	80 acres
	N1/2 SE1/4	80 acres
	N1/2 S1/2 SE1/4	40 acres
Total		245.61 acres

See Map 1 for location and details.

PART 1 - ITEM 9

9. Statement of technical and financial capability to construct, operate and terminate the use for which authorization is requested, including the protection and restoration of federal lands:

PacifiCorp, an Oregon corporation wholly-owned by Scottish Power, is a diversified electric utility company serving 1.5 million retail customers in western United States (third largest electric utility west of the Rocky Mountains). Scottish Power is an investor-owned entity with PacifiCorp representing assets of $1,742.2 million with annual revenues of $4,899.6 million.

Interwest Mining Co. & Energy West Mining Co. are both wholly-owned subsidiaries of PacifiCorp.Interwest Mining Co. is PacifiCorp's managing agent, and Energy West Mining Co. is the mine operator of its Deer Creek, Cottonwood, Des-Bee-Dove and Trail Mountain mines. PacifiCorp, through its predecessor, Utah Power & Light Co., has owned and operated the mines in the local vicinity for nearly 30 years.

All equipment, personnel and technical expertise are currently in place at the Deer Creek Mine to develop these underground entries in the right-of-way areas. The underground right-of-way will be constructed, maintained, operated and terminated in accordance with all applicable state, federal and local regulations.

PART 1 - ITEM 10

a. Describe other reasonable alternative proposals considered:

A variety of alternatives were evaluated in order to access State Coal Lease ML-48258. An underground access corridor from Federal Coal Lease U-06039 to State Coal Lease ML-48258 minimizes environmental disturbance and maximizes resource recovery. PacifiCorp has considered (1) a lease modification, (2) emergency leasing, and (3) underground right-of-way. In discussions with the USFS and BLM, the underground right-of-way appears to be the most simplistic and correct mechanism to achieve the desired results for all parties.

b. Give explanation of why it is necessary to utilize federal lands and why the alternatives in item 10a were not selected:

In addition to the comments in Part 1 Item 10 a. (above) it is necessary to utilize federal lands because of the dominance of federal lands in the area. It is imperative to use adjacent lands to federal coal lease U-06039, as there is no other choice. This is crucial to the development and maximum economic recovery of coal reserves in ML-48258.

A lease modification would essentially serve the same purpose, but the intent with this application is to minimize mine development in these areas to eventually maximize the recovery in ML-48258. A lease modification is acreage restricted. Emergency leasing is a viable option, however, the timing process would also hinder overall production planning and coal delivery requirements.

The underground rights-of-way provides the better of the alternatives simply because it (1) does not create any new surface disturbance, (2) it allows use of the Deer Creek Mine existing infrastructure for coal haulage, processing, loading and unloading of coal, (3) visual impacts remain unchanged, and (4) the timing to permit and acquire said rights-of-way appears to be more conducive to development and production criteria.

PART 1 - ITEM 11

Provide statement of need for proposed use, including the economic feasibility and items such as:

PacifiCorp has a significant investment in the acquisition of the Mill Fork Lease ML-48258 reserves. This acquisition was predicated by the need to acquire additional reserves to provide a continual and reliable long term fuel supply for the Huntington Power Plant. Therefore, PacifiCorp recommends that this application for the requested underground right-of-way be granted to accomplish an effective access to State Coal Lease ML-48258. This alternative mine plan further compliments the purpose of extending the coal reserve base.

a. Cost of proposal (construction, operation and maintenance):

In the spirit of what this application is intended for, the costs of developing the entries in the right-of-way areas will hopefully be offset by the long range benefits of increased longwall coal recovery. This of course, is a risk to the applicant with none to the public. In return, this would provide additional royalties to the public which would not otherwise be realized. These portions of the existing reserves would not otherwise be mined since the reserves fall outside of the existing federal and state coal lease boundaries.

b. Estimated cost of next best alternative:

No other alternatives were considered due to timeliness and potential lost production.

c. Expected public benefits:

PacifiCorp as owner of the mine and power plant employs approximately 900 people in the local area which is a significant factor in providing some stability to the socioeconomics in the area. In addition, the granting of the underground right-of-way will encourage (1) the greatest ultimate use of a public resource, (2) maximization of coal recovery with no anticipated impacts, and (3) additional royalty revenue to the public.

PART 1 - ITEM 12

Describe probable effects on the area population, including social and economic aspects and rural lifestyle:

It is not anticipated that there would be any effects to the area population nor would it have any effect on the social and economic aspects. Depending upon the disposition of this application, it will either increase or decrease the mine life.

PART 1 - ITEM 13

Describe likely environmental effects that the proposed use will have on:

a. Air quality: None

b. Visual impact: None

c. Surface and ground water quality and quantity: None (PacifiCorp proposes first mining/no subsidence mining within the right-of-way).

d. Control or structural change on any stream or other body of water: There will be no control or structural change to any stream or body of water as a result of this underground mine access.

e. Existing noise levels: No additional noise will be created by the right-of-way.

f. Land surface, including vegetation, permafrost, soil and soil stability: None anticipated - refer to attached reports.

g. Populations of fish, plant, wildlife and marine life, including threatened and endangered species: None.

PART 1 - ITEM 14

Describe what actions will be taken to protect the environment from the effects of the proposed use:

The right-of-way will have no effect on the surface. The underground mine entries and pillars will be designed and constructed in accordance with the best available technology, engineering practices and historical experience to eliminate surface subsidence. No pillar extraction or second mining will occur in the right-of-way areas.

PART 1 - ITEM 15

Name all Federal, State, County or other department(s) / agency(ies) where an application for this is being filed. Attach appropriate license, building permit, certificate or other approval document:

United States Forest Service
Manti-LaSal National Forest
599 West Price River Drive
Price, Utah 84501

U.S. Department of the Interior
Bureau of Land Management
Utah State Office
324 South State Street, Suite 301
Salt Lake City, Utah 84111-2303

U.S. Department of the Interior
Bureau of Land Management
Price Field Office
125 South 600 West
Price, Utah 84501

State of Utah
Division of Oil, Gas & Mining
1594 West North Temple, Suite 1210
Box 145801
Salt Lake City, UT 84114-5801

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November 2000

State of Utah
School and Institutional Trust Lands Administration
675 East 500 South, Suite 500
Salt Lake City, Utah 84102

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Mill Fork Right-of-Way Application

PACIFICORP

ENERGY WEST Mining Co.

DEER CREEK MINE
MILL FORK ACCESS

Drawing # CM-10905-DR

Deer Creek Mine
Underground Right-of-Way
Mining Plan

November 2000

Mill Fork Right-of-Way Application

PACIFICORP

ENERGY WEST Mining Co.

DEER CREEK MINE
MILL FORK ACCESS

Analysis of Long Term Entry Stability and the Potential for Surface Influence of Entry Development Outside the Current Lease Boundary of Federal Lease U-06039, November 2000

November 2000

DEER CREEK MINE
MILL FORK LEASE ACCESS

ANALYSIS OF LONG TERM ENTRY STABILITY AND THE POTENTIAL FOR SURFACE INFLUENCE OF ENTRY DEVELOPMENT OUTSIDE THE CURRENT LEASE BOUNDARY OF FEDERAL LEASE U-06039
NOVEMBER 2000

INTRODUCTION:

Per the current mine plan for the Deer Creek Mine, it is proposed that main access entries [6-entry system] be developed from the current mine workings [located in the western portion of Federal Lease U-06039, Hiawatha Seam], west across the current permit / lease boundary of Federal Lease U-06039 to the present lease boundary of State of Utah Coal Lease ML-48258 [Mill Fork Lease Tract]. This proposed development is necessary to provide the most direct access to the Mill Fork lease reserves from the present Deer Creek underground mine workings [See Attachment #1; Mine Plan; Deer Creek Mine].

A "Special Use / Right-of-Way" approval is required from State and Federal regulatory agencies to allow this proposed development to occur. As a requirement, the Lessee is to analyze the long term entry stability and the potential for surface influence of entry development outside the current lease boundary of Federal Lease U-06039. Based on the current mine plan projections, it is estimated that approximately 466,223 tons of development coal [approximately 6100 ft. of 6-entry mains] will be removed outside the existing lease boundary to facilitate the proposed underground access development.

Long term stability of mine pillars and mine openings is extremely difficult to determine empirically. Presently, a generalized, representative model for long term stability or subsidence prediction for partial extraction development mining is not available.

Within this report, three general analyses are made: (1) Empirical Pillar Stability , (2) Laminated Beam and (3) Chimney Caving. It should be noted that these empirical analyses have many limitations, and are used as a design starting point. Site specific knowledge along with documented historical observation are still the best tools for mine design and long term stability analysis.

EMPIRICAL PILLAR STABILITY ANALYSIS:

The proposed access development outside the existing lease boundary is to be composed of a 6-entry mains system. Main entry pillar size is proposed at 60 ft. (effective pillar width) X 110 ft. (effective pillar length) (i.e.: 80ft. x 130ft. entry centers). Depth of cover over the area referenced ranges from approximately 600 ft. to 2000 feet. Average depth of cover is assumed to be approximately 1400 feet.

There are numerous empirical pillar stability formulas available to analyze short term and long term pillar stability (Bieniawski; Obert-Duvall/Wang; Holland; Holland-Gaddy; Salamon-Munro; etc.). Most of the empirical formulas presented are derived from site specific field analysis of pillar stability at a particular mine site and have limited flexibility for varying conditions. Thus, results from these empirical calculations represent limited accuracy and a wide range of factors of safety. It is standard industry practice to select a particular formula which best represents the conditions being analyzed and use the results as a starting point for design. From this starting point, the mine layout and design are refined by incorporating applicable mine site conditions and historical observation.

Appendix #1 (attached) provides documentation regarding assumptions, calculations, and resulting factors of safety for the various empirical formulas. **Please note that none of the formulas discussed give consideration to the number of entries mined or to the redistribution of load to the surrounding coal barrier pillars. These factors have a significant impact on pillar and entry stability.** Stress in coal pillars is more highly concentrated near the rib line and decreases toward the center of the pillar. The center of the pillar, the pillar core, is left relatively undisturbed and intact. The strength of the pillar core is increased because of the confining constraint of the material outside the core (Peng, 1978). **The above referenced formulas do not take this confining pressure into account which also has significant positive impact on the real strength and subsequent long term stability of the coal pillars.**

Calculated results from the various formulas represent a one-dimensional analysis of vertical loading on a given pillar, based on size and strength of the pillar and depth of cover. For long term stability, a factor of safety from 1.6 - 2.0 is recommended. For the 60ft. x 110ft. pillars proposed, the resulting factors of safety range from 0.70 to 1.42. In order to achieve the recommended factor of safety of 2.0, pillar size would need to be increased to approximately 80 ft. x 140 ft., or approximately 1.7 times the proposed pillar size. It is evaluated, based on standard industry practice, mine site conditions, and historical observation that the 80 ft. x 140 ft. pillar is not a reasonable or prudent design.

These empirical results are considered as ultra-conservative and not realistic for the site specific conditions present at the Deer Creek Mine. Considering the proposed access development layout, site specific geologic and lithologic conditions present at the Deer Creek Mine, and observed historical stability of the standard pillar layouts used at the Deer Creek, Cottonwood, and Trail Mountain Mines in similar conditions; it is recommended that the proposed 60 ft. x 110 ft. entry support pillar configuration is adequately sized for long term entry stability as proposed in the Deer Creek Mine plan.

LAMINATED BEAM ANALYSIS:

Another empirical approach to long term entry stability evaluation is a Laminated Beam Analysis. This method of analysis is only applicable if bed separation occurs in the immediate roof strata within the zone of influence of the mine opening(s), which in turn forms a roof beam above the developed entry(s). In this regard, a roof beam should have a span to thickness ratio greater than 5 and preferably 8 to insure applicability of beam theory. Empirical beam analysis considers the mechanical strength and/or weakness of the roof beam created and possible mode(s) of failure.

Beam failure is considered to be mainly a result of the magnitude of tensile stress generated within the roof beam by excavation of the mine entry(s). When this tensile stress exceeds the natural strength of the material constituting the beam, failure occurs. Progressive upward movement of the collapse process is triggered by shear failure at the ribline of the opening coupled with detachment of the roof within the central area of the zone of influence (i.e.: center of entry) - (Whittaker, 1989).

From historical experience and observation, entry stability performance at the Deer Creek, Cottonwood, and Trail Mountain Mines, under similar conditions, does not approach complete entry and/or roof failure. On a long term basis, entry deterioration is expected in the form of roof and rib spalling. Roof bolting is considered in the analysis and is a significant factor when determining structural strength of the beam. Roof bolts act as dowels through the immediate roof strata and prevent bed separation within the immediate roof, increasing overall beam strength and reducing the possibility of complete beam/entry failure.

Due to the lack of detailed / measured (quantitative) field data concerning applicable roof rock structural properties (i.e.: bed consistency, localized disconformities, mechanical strengths of the various beds, etc.) and the lack of any site specific documentation of complete entry failure, reliable use of this type of **empirical** analysis in determining long term entry stability and possible surface influence is evaluated as not appropriate at this time.

When evaluating possible entry failure and long term surface impact from the proposed access development the analysis must fully consider the type and amount of primary and secondary roof support used by Energy West in main entry developments. Also, full consideration must be given to the size and effect of the solid coal protective barriers surrounding the proposed access entry developments. Based on these considerations, along with the observed entry stability history with regard to the Deer Creek, Cottonwood, and Trail Mountain Mines, it is concluded that any possible long term surface effect from the proposed access entry development outside the existing permit boundary at the Deer Creek Mine is highly unlikely.

CHIMNEY CAVING ANALYSIS:

The Chimney Cave analysis assumes (worst case) complete mine entry intersection or entry/pillar failure. The evaluation then becomes whether or not subsidence might be realized at the surface. The most important factor for this method of analysis is considered to be the bulking factor or bulk porosity of the overlying strata. Site specific geologic conditions, strength of the immediate roof, opening and pillar dimensions, depth of cover, geometry of the workings, the presence or absence of ground water and the degree of active support are all important factors which should be taken into consideration when utilizing this method of analysis.

In Appendix #2 (attached), two relevant Chimney Caving evaluations complete with detailed assumptions and calculations are presented. Given the maximum entry and development widths for multiple entry access development proposed outside the current lease boundary of Federal Lease U-06039 along with the predicted mining height and geologic makeup of the overlying strata, calculated chimney cave heights range from 76.5 feet to 134 feet within an average depth of cover of 1400 feet.

It is apparent from these calculations that subsidence from the proposed developments outside the current lease boundary is unlikely to have any surface effect, **even when full failure of the developed workings is assumed.**

DISCUSSION OF REVIEWED LITERATURE:

In room and pillar development, without pillar recovery, the stability of the opening will deteriorate with time. Deterioration of these abandoned pillars and adjacent strata will proceed until all voids created by the development mining have been filled by the caving strata. Subsidence may be avoided if certain conditions are fulfilled (SME Handbook, 1992):

- Sufficient coal is left (not mined) to serve as load-bearing pillars. (Generally greater than 50%).
- Mining is conducted at sufficient depth.
- Strata overlying the workings contain competent beds.

Using the proposed (standard) 60 ft. x 110 ft. pillar under approximately 1400 ft. of cover for access development support along with leaving sufficient solid coal barriers to protect the referenced entries from surrounding mining induced stresses, it is evaluated sufficient coal is left in-place at a sufficient depth to serve as load-bearing strata, providing the proposed entries with sufficient stability as well as protecting the surface from subsidence.

Appendix #3 (attached), contains a lithologic log of a surface exploration drill hole presented as a representative model of a typical Deer Creek Mine (Rilda Canyon area) lithologic column. This log shows the presence of a massive rock units above the mining horizon, as well as other acceptable load-bearing units of substantial thickness. It is evaluated that these structural units should inhibit any possible strata caving, influenced from the proposed partial extraction development of access entries, from surface influence. It is also noted from the lithologic log, the presence of a substantial lithologic unit (Star Point Sandstone) below the mining horizon. It is evaluated that this structural member will prevent the entry support pillars from "punching through" the mine floor. As stated above, pillar deterioration is expected on a long term basis in the form of progressive spalling and yielding of the mine entries. However, catastrophic failure of the pillars and entries is not expected.

The conservative nature of Empirical Pillar Stability Analysis ignores the condition that the thick, massive sandstone beds above and below the mining horizon are capable of bridging across hundreds of feet. Site specific, local mining conditions dictate appropriate pillar dimensions, not general empirical formulas (Parker, 1993).

CONCLUSION:

From the various forms of analysis evaluated and presented above, considering the long term stability and the potential for surface influence of access entry development outside the current lease boundary of Federal Lease U-06039; it is concluded that partial extraction development outside the lease boundary will have **NO SURFACE IMPACT** and is therefore, proposed for access development mining necessary to facilitate access to State of Utah Coal Lease ML-48258.

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Whittaker, B.N. and Reddish, D.J., 1989, Subsidence: Occurrence, Prediction, Control; Ney York; pg. 15 - 201.

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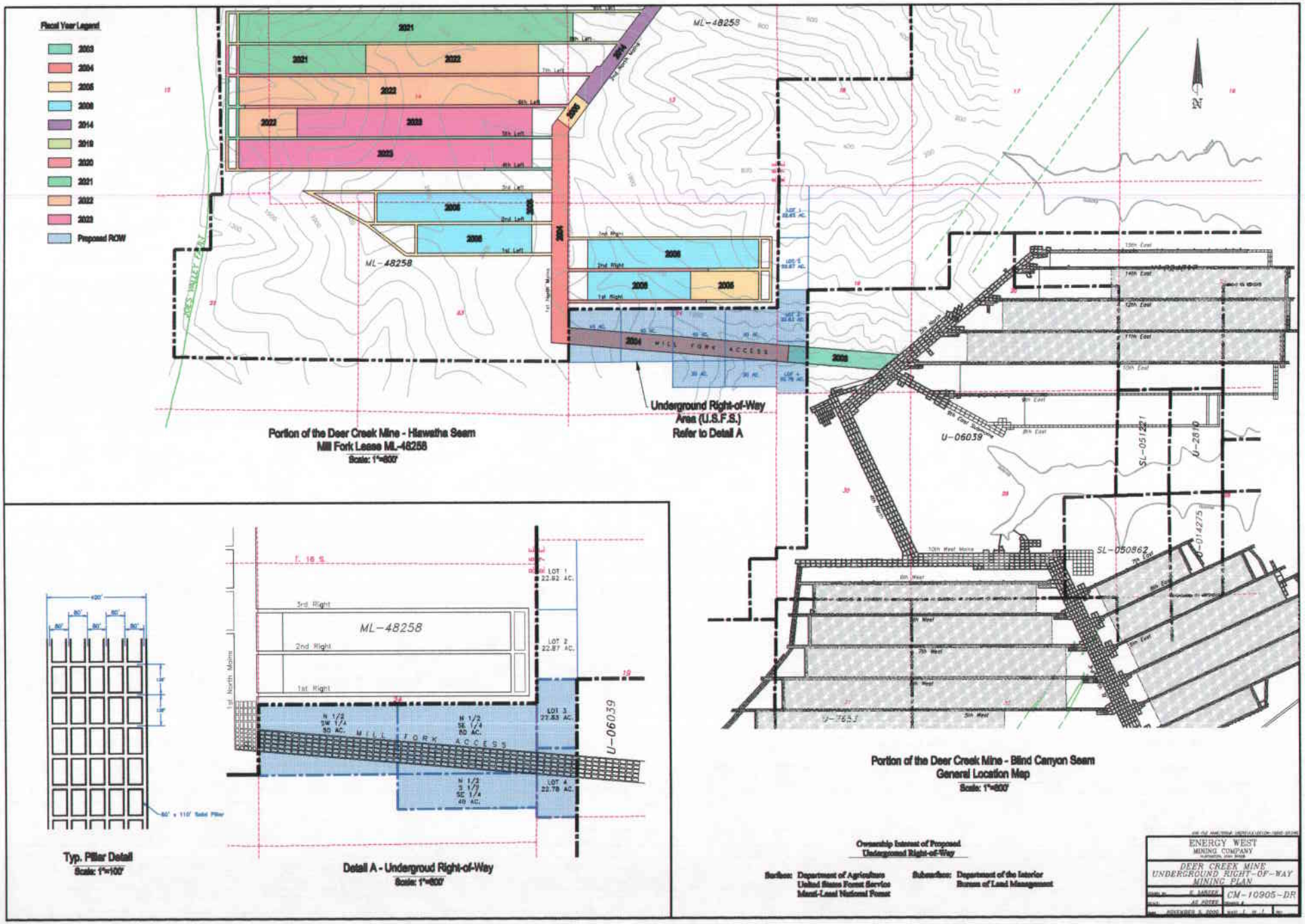
ATTACHMENT #1
UNDERGROUND RIGHT-OF-WAY MINE PLAN MAP
DEER CREEK MINE


Fiscal Year Legend
2003
2004
2005
2006
2014
2019
2020
2021
2022
2023
Proposed ROW
ML-48258
ACS VALLEY RD.
MILL FORK ACCESS
Underground Right-of-Way Area (U.S.F.S.) Refer to Detail A
Portion of the Deer Creek Mine - Hiawatha Seam
Mill Fork Lease ML-48258
Scale: 1"=800'
U-06039
SL-051221
U-2810
SL-050862
U-014275
U-7653
Portion of the Deer Creek Mine - Blind Canyon Seam
General Location Map
Scale: 1"=800'
3rd Right
2nd Right
1st Right
1st North Mains
LOT 1 22.92 AC.
LOT 2 22.87 AC.
LOT 3 22.83 AC.
LOT 4 22.78 AC.
N 1/2 SW 1/4 SE 1/4 40 AC.
Typ. Pillar Detail
Scale: 1"=100'
Detail A - Underground Right-of-Way
Scale: 1"=800'
Ownership Interest of Proposed Underground Right-of-Way
Surface: Department of Agriculture United States Forest Service Manti-Lasal National Forest
Subsurface: Department of the Interior Bureau of Land Management
ENERGY WEST MINING COMPANY
DEER CREEK MINE
UNDERGROUND RIGHT-OF-WAY MINING PLAN
CM-10905-DR

APPENDIX #1

- PILLAR DESIGN FORMULAS
- DETERMINATION OF PILLAR STRENGTH (SME HANDBOOK)
- EMPIRICAL PILLAR STABILITY ANALYSIS CALCULATIONS

PILLAR DESIGN FORMULAS

PILLAR LOAD: $S_p = 1.1\ H\ \{[(w + B)/w] \times [(L + B)/L]]\}$

Where: S_p = Avg. Pillar Stress (psi)

H = Overburden (ft.)

B = Entry Width (ft.)

w = Pillar Width (ft.)

L = Pillar Length (ft.)

SIZE EFFECT: $\sigma_{cube} = k / \sqrt{36}$ Where $k = \sigma_c\ (\sqrt{D})$

Where: σ_{cube} = UCS of a Cube (psi)

σ_c = UCS of a Lab Specimen (psi)

D = Lab Speciment Dia. (ins.)

PERCENT EXTRACTION: $e = 1\ (-)\ [(w/w+B) \times (L/L+B)]$

Where: e = Percent Extraction (%)

PILLAR STRENGTH FORMULAS:

Bieniawski: $\sigma_p = \sigma_{cube}(0.778 + 0.222\ w/h)$

Obert-Duvall/Wang: $\sigma_p = \sigma_{cube}(0.778 + 0.222\ w/h)$

Holland: $\sigma_p = \sigma_{cube}(\sqrt{w/h})$

Holland-Gaddy $\sigma_p = k(\sqrt{w})/h$

Where: w and h are expressed in inches

Salamon-Munro $\sigma_p = k(w^{.46})/\sqrt{12}\ (h^{.66})$

Where: σ_p = Strength of Pillar (psi)

σ_{cube} = Strength of a Cube (psi) = $k/(\sqrt{36})$

Where: $k = \sigma_c(\sqrt{D})$

Where: σ_c = UCS (Lab Specimen) (psi)

D = Lab Specimen Diameter (in)

Where: w = Width of Pillar (ft.)

h = Height of Pillar (ft.)

FACTOR OF SAFETY:

$$FS = \sigma_p / S_p$$

RECOMMENDED FACTORS OF SAFETY:

- Bieniawski ---------- 2.0
- Obert-Duvall/Wang ---------- 2.0
- Holland ---------- 2.0
- Holland-Gaddy ---------- 2.0
- Salamon-Monro ---------- 1.6

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1. Mining Engineering Handbook, 2nd Edition, 1992
2. Interwest Mining Technical Services Report, PS0044, 1993
3. IC-9315, Proceedings of the Workshop on Coal Pillar Mechanics and Design, Bureau of Mines, 1992

EMPIRICAL PILLAR STABILITY ANALYSIS

Regular: 60' X 110'

Pillar Load:

Overburden Density (lbs/ft³): 158
Overburden Thickness (ft.): 1400
Entry Width (ft.): 20
Pillar Width (ft.): 60
Pillar Length (ft.): 110
Mining Height (ft.): 8.5
Extraction Ratio (%): 36.5%

Avg. Pillar Stress (psi) = 2426.67 psi

Coal Sample Properties:

Lab Specimen Diameter (in.): 2.15"
Uniaxial Compressive Strength (psi): 4431 psi (Average)

Pillar Strength:

	Pillar Strength (psi)	Factor of Safety
Bieniawski:	3444.75	1.42
Obert-Duvall/Wang:	2539.36	1.05
Holland:	2876.96	1.19
Holland-Gaddy:	1709.18	0.70
Salamon-Munro:	3003.75	1.24

**Based on Equations 10.5.21 through 10.5.35 SME Handbook, 1992, pg. 923-928

EMPIRICAL PILLAR STABILITY ANALYSIS

Regular: 60' x 80'

Pillar Load:

Overburden Density (lbs/ft³):	158
Overburden Thickness (ft.):	1400
Entry Width (ft.):	20
Pillar Width (ft.):	60
Pillar Length (ft.):	80
Mining Height (ft.):	8.5
Extraction Ratio (%):	40%

Avg. Pillar Stress (psi) = 2566.67 psi

Coal Sample Properties:

Lab Specimen Diameter (in.):	2.5"
Uniaxial Compressive Strength (psi):	4431 psi (Average)

Pillar Strength:

	Pillar Strength (psi)	Factor of Safety
Bieniawski:	3444.75	1.34
Obert-Duvall/Wang:	2539.36	0.99
Holland:	2876.96	1.12
Holland-Gaddy:	1709.18	0.67
Salamon-Munro:	3003.75	1.17

**Based on Equations 10.5.21 through 10.5.35 SME Handbook, 1992, pg. 923-928

EMPIRICAL PILLAR STABILITY ANALYSIS

Regular: 80' x 140'

Pillar Load:

Overburden Density (lbs/ft³): 158
Overburden Thickness (ft.): 1400
Entry Width (ft.): 20
Pillar Width (ft.): 80
Pillar Length (ft.): 140
Mining Height (ft.): 8.5
Extraction Ratio (%): 30%

Avg. Pillar Stress (psi) = 2200 psi

Coal Sample Properties:

Lab Specimen Diameter (in.): 2.15"
Uniaxial Compressive Strength (psi): 4431 psi (Average)

Pillar Strength:

	Pillar Strength (psi)	Factor of Safety
Bieniawski:	4361.99	1.98
Obert-Duvall/Wang:	3104.99	1.41
Holland:	3322.03	1.51
Holland-Gaddy:	1973.59	0.90
Salamon-Munro:	3428.75	1.56

**Based on Equations 10.5.21 through 10.5.35 SME Handbook, 1992, pg. 923-928

$$h_t = \left(\frac{100 - \text{RMR}}{100}\right) B = \left(\frac{100 - 41}{100}\right) 20$$

$$= 11.8 \text{ ft} \simeq 12 \text{ ft (3.7m)}$$

(If the RMR value is not known, the rock-load height can be estimated from roof-fall data by taking the roof-fall height as the rock-load height).

Step 2. Find the bolt length.

$$L = \frac{h_t}{2} = 6 \text{ ft}$$

$$\text{or } L = \text{SPAN}/3 = 20/3 = 6.7 \text{ ft}$$

$$\text{or } L = (\text{SPAN})^{2/3} = 7.2 \text{ ft}$$

Use $L = 6$ ft (1.78 m) as a practical bolt length. This would provide anchorage in the sandstone (Fig. 10.5.15).

Step 3. Find the bolt capacity.

The anchorage failure load P_f from pull-out tests is given as 8.9 tons (8.0 t). The yield load P_y of bolts can be checked for bolt diameter ϕ and grade of steel G from manufacturers' data, e.g.,

ϕ	G	P_y	G	P_y
⅝ in.	60	9.3 tons	40	6.2 tons
¾ in.	60	13.2 tons	40	8.8 tons

Select ¾-in. bolt, $G = 60$. Thus, bolt capacity is 8.9 tons.

Step 4. Calculate bolt spacing.

The bolt spacing is calculated using the suspension principle:

$$S = \sqrt{\frac{0.6\,P}{\gamma h}} = \sqrt{\frac{0.6 \times 17800}{150 \times 5.25}} = 3.68 \text{ ft}$$

Thus: $S = 3$ ft 7 in. (1.12 m). Use $S = 4$ ft (1.2 m).
Check: $L/S = 1.5$. Use four bolts per row.

Step 5. Find the bolt tension (mechanical bolts only) = 60% of bolt capacity.

Step 6. Compare mechanical bolting with resin bolting.

The final choice between the two types of roof bolting should be made on economic grounds. Select mechanical bolts.

Step 7. General considerations.

Always prepare a sketch of the rock bolt layout, to scale, to check whether it is practicable. It should be noted that in Ex. 10.5.2, no use is made either of the beam theory nor of the Panek chart for friction effect. Both these approaches are considered out of date: the first one because it needs the unrealistic assumption of the "modulus of rupture" (tensile strength), which is an unreliable parameter and rarely available at that; and the second, because it is oversimplified and has been abandoned by the Bureau of Mines where it was originally developed (Panek, 1973).

It should further be noted that no distinction is made in the example between the tensioned mechanical bolts and untensioned grouted bolts when it comes to the selection of the bolt length. This is so because the bolt length is the function of the excavation size and the rock mass quality. However, due to better anchorage characteristics, grouted bolts result in larger bolt spacing; they are also preferable for longer applications (e.g., in the main entries).

10.5.8 DETERMINATION OF PILLAR STRENGTH

Experimental results from tests on rock and coal show that there is a strength-reduction effect with increasing specimen size (Fig. 10.5.8).

The concept of *critical-size strength* (Bieniawski, 1968) for rock masses is very important in practical design. The critical size is defined as that specimen size at which a continued increase in specimen width causes no significant decrease in strength. Other authors (Jahns, 1966; Lama, 1971; Pratt et al., 1972) have confirmed that this critical-sized phenomenon exists in various rock types.

For coal, it was concluded by Bieniawski (1968) that 5-ft (1.5-m) cubic specimens constitute the critical-size value. Parnseau (1977) reported that the critical size for US western coal is 3 ft (0.9 m). Hustrulid (1976) pointed out that a critical size of 3 ft (0.9 m) would be generally applicable for coal for practical engineering purposes. This is evident from Fig. 10.5.8(b) where his data for the Pittsburgh coal seam are depicted.

The significance of the phenomenon of critical size is, of course, that the strength values at the critical size are directly applicable to full-sized pillars.

The size effect characterizes the difference in strength between the small-sized specimens tested in the laboratory and the large-sized pillars mined in situ. Research has shown (Hustrulid, 1976) that the scaling of coal properties from laboratory-measured data to field values can be satisfactorily achieved by the following equations (in customary English units):

$$\sigma_1 = \frac{k}{\sqrt{36}} \qquad (10.5.18)$$

applicable to cubical pillars having a height $h > 36$ in. (0.9 m), or

$$\sigma_1 = \frac{k}{\sqrt{h}} \qquad (10.5.19)$$

applicable to cubical pillars having a height less than 36 in. (0.9 m).

In the above equations, the constant k must be determined for the actual pillar material and is obtained as shown by Gaddy (1956):

$$k = \sigma_c \sqrt{D} \qquad (10.5.20)$$

where σ_c is uniaxial compressive strength of rock specimens tested in the laboratory having a diameter or cube size dimension D (in inches). It should be noted that although there is a difference in laboratory results depending on whether cylindrical or cubical specimens are used, for practical engineering purposes this difference is not significant within the range of D between 2 to 4 in. (50 to 100 mm) (see Fig. 10.5.8b).

Typical k values for different coal seams are listed below:

Seam	k	Seam	k
Cameo (CO)	3200–7970	MaryLee (AL)	3000
Clintwood	4230–5200	Pittsburgh (PA, WV)	5550–5860(av.5580)
Elkhorn No. 4	6000–6250	Pocahontas	4310–4825
Harlan	8860–9460	Springfield #5 (IL)	4930
Herrin #6 (IL)	5500	Upper Freeport (PA)	1640
Marker	10120–10600	Winifrede (WV)	6510

10.5.8.1 Pillar Strength Formulas

Numerous pillar strength formulas have been proposed, but five formulas are used most commonly (Bieniawski, 1984; Peng, 1986). Each formula specifies its own appropriate factor of safety.

1. Obert-Duvall/Wang Formula: Obert and Duvall (1967) derived from laboratory tests on hard rock and elasticity consid-

erations the same relationship as did Bunting in 1911. Greenwald et al. (1939) mention that this form of an expression for pillar strength was proposed in 1900 for anthracite after laboratory tests made for the Scranton Engineers Club. This formula is given as

$$\sigma_p = \sigma_1 \left(0.778 + 0.222 \frac{w}{h}\right) \qquad (10.5.21)$$

where σ_p is pillar strength, σ_1 is uniaxial compressive strength of a cubical specimen ($w/h = 1$), and w and h are pillar dimensions.

According to Obert and Duvall, this equation is valid for w/h ratios of 0.25 to 4.0, assuming gravity-loading conditions. Through back calculations from mining case histories and utilization of laboratory rock properties, safety factors of 2 to 4 were derived for short- and long-term pillar stability, respectively. Essentially, this safety factor accounts for strength scaling from laboratory (or rock-material) strength to in situ (or rock-mass) strength for hard rock.

In 1975, Wang, Skelly, and Wolgamott of the Colorado School of Mines (CSM) conducted in situ tests on a coal pillar located in West Virginia (Wang et al., 1977). The tests consisted of reducing pillar dimensions until failure occurred and then determining the pillar strength. The authors proposed the same formula as above and defined σ_1 as the ultimate strength of a cubical specimen of critical size or greater. The recommended factor of safety is 2.0, although $F = 1.5$ is acceptable if mining conditions are well known.

The CSM research was important for a number of reasons. First, Eq. 10.5.21, was applied to coal strata. Second, the term σ_1 was defined acknowledging the existence of a critical sized phenomenon. Third, the equation was stated as being valid for w/h ratios up to 8.

2. Holland-Gaddy Formula: Holland (1964) extended the work by Gaddy (1956) and proposed the following formula:

$$\sigma_p = \frac{k\sqrt{w}}{h} \qquad (10.5.22)$$

where k is the Gaddy factor from equation 10.5.20, w and h are pillar dimensions in in., and σ_p is pillar strength in psi. Holland specified a safety factor between 1.8 and 2.2 for the design of coal pillars, with a recommended value of 2.0. The width-to-height ratio, for which the Holland formula is valid, ranges from 2 to 8. Although popular in the 1970s, the Holland-Gaddy formula is no longer recommended because it was found to be overly conservative at higher $\frac{w}{h}$ ratios (> 5).

3. Holland Formula: In a paper published in 1973, Holland provided a different expression for the strength of coal pillars, namely:

$$\sigma_p = \sigma_1 \sqrt{\frac{w}{h}} \qquad (10.5.23)$$

where σ_1 is the strength of cubical pillars ($w = h = 1$). In effect, σ_1 can be interpreted as the strength at the critical size of coal specimens and is to be determined from Eq. 10.5.18. The recommended factor of safety is 2.0.

4. Salamon-Munro Formula: Salamon and Munro (1967) conducted a survey of failed and standing coal pillars in South Africa. Based on the studies of Holland (1964) and Greenwald et al. (1939), they selected the following form of pillar strength to apply to square pillars:

$$\text{strength} = Kh^{\alpha}w^{\beta} \qquad (10.5.24)$$

The constants for the above equation were derived from a statistical survey of data reflecting actual mining experience. In all, 125 case histories were used, of which 98 were standing pillars and 27 were failed pillars (collapsed at the time of the analysis). In deriving a pillar strength formula, it was assumed that those pillars that were still intact had safe dimensions, while the collapsed pillars were too small. The following pillar strength formula was proposed:

$$\sigma_p = 1320 \frac{w^{0.46}}{h^{0.66}} \qquad (10.5.25)$$

where the strength σ_p is in psi, and the pillar dimensions w and h are in feet. The recommended safety factor for this formula is 1.6, the range being 1.31 to 1.88.

In SI units, the above equation becomes:

$$\sigma_p = 7.2 \frac{w^{0.46}}{h^{0.66}} \qquad (10.5.26)$$

where the strength σ_p is in MPa while w and h are in meters.

This statistical formula is applicable to South African conditions, and it represents the average strength data for coal pillars in that country. Since there are considerable variations in coal strength between the various mines in South Africa (Bieniawski and van Heerden, 1975), the Salamon-Munro formula is currently being modified in South Africa in two respects: (1) by incorporating the actual strength of coal in a mine rather than the average coal strength in the country, and (2) by extending its use for a w/h ratio of 5 and above (Wagner, 1982). The first aspect can be simply achieved by the use of Eq. 10.5.19 when working in English units or using Eq. 10.5.18 and converting σ_1 to SI units for substitution in place of factor 7.2 in Eq. 10.5.26. Thus in English units, the Salamon-Munro formula is of the form,

$$\sigma_p(\text{psi}) = \frac{k}{\sqrt{12}} \frac{w^{0.46}}{h^{0.66}} \qquad (10.5.27)$$

5. Bieniawski Formula: This formula is based on large-scale in situ tests on coal pillars. Such tests were first undertaken in the United States by Greenwald et al. (1939) during the period 1933–1941. Extensive tests were conducted in South Africa during 1965–1973 by Bieniawski (1968, 1969), Wagner (1974), and Bieniawski and van Heerden (1975). Wang et al. (1977) conducted in the United States the largest test of all involving one full-sized coal pillar measuring 80 ft (24 m) in width. All these investigations examined the various pillar-strength formulas.

To make the in situ test results generally applicable (i.e., not only to the locality where the actual tests were carried out), the pillar-strength formula can be expressed in a normalized form. For example, the original formula for the Witbank coalfield (Bieniawski, 1967) was of the form,

$$\sigma_p = 400 + 220 \frac{w}{h} \qquad (10.5.28)$$

where σ_p is in units of psi. This can be represented dimensionlessly as

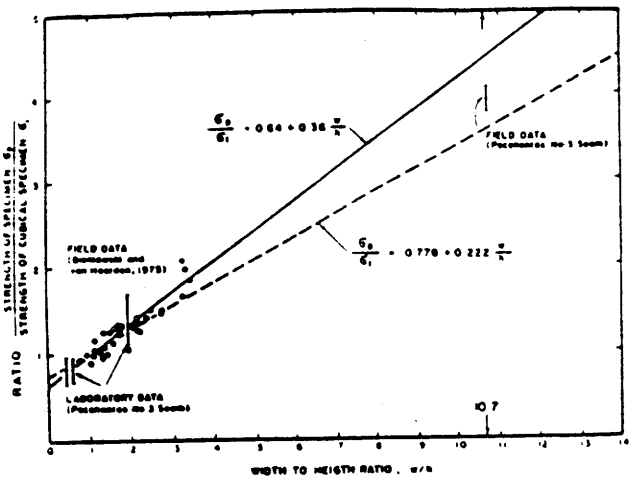


Fig. 10.5.16. The effect of specimen width-to-height ratio on the uniaxial compressive strength of coal pillars (Wang et al., 1977; Bieniawski and van Heerden, 1975).

$$\sigma_p = 620\left(0.64 + 0.36\frac{w}{h}\right) \qquad (10.5.29)$$

where $\sigma_1 = 620$ psi is the critical-size strength for the Witbank coalfield. Thus the general normalized form of the Bieniawski equation is

$$\sigma_p = \sigma_1\left(0.64 + 0.36\frac{w}{h}\right) \qquad (10.5.30)$$

where σ_p is pillar strength, w is pillar width, h is pillar height, and σ_1 is the strength of a cubical specimen of critical size or greater (e.g., about 3 ft or 1 m for coal).

Bieniawski (1969) and Bieniawski and van Heerden (1975) confirmed this relationship by large-scale in situ tests on 66 coal specimens of width-to-height ratios from 0.5 to 3.4.

The formula is particularly realistic for w/h ratios up to 10, after which it provides conservative estimates (Fig. 10.5.16). However, for high w/h ratios, it is the least conservative formula by comparison with the other four formulas. As this formula is applicable to any mine pillar with a value of σ_1 characterizing the in situ strength of the rock strata, Holland (1973) suggested that a safety factor of two would be generally adequate for US coal mining applications.

To clarify this point, a national survey of coal pillar and roof span dimensions and design procedures in the United States was reported by Bieniawski (1983) that features 171 cases of standing pillars, 23 cases of failed pillars, and 58 cases of roof failures (see Fig. 10.5.17). It was shown that factors of safety ranging from 1.5 to 2.0 would be applicable to coal mining in the United States using the Bieniawski pillar strength formula (Eq. 10.5.30). The value of $F = 1.5$ is recommended for short term applications (e.g., in the panels) while $F = 2.0$ should be used in the mains and when pillar recovery on retreat is contemplated. Nevertheless, these recommendations should be regarded as a guide only, and local mining experience should be taken into consideration.

The application for pillar strength formulas to room and pillar mining is covered in 10.5.6.4 and Chapter 18.1.

10.5.6.2. Pillar Load Determination

A number of approaches are available for estimating the *pillar load* or, more correctly, the average pillar stress. The

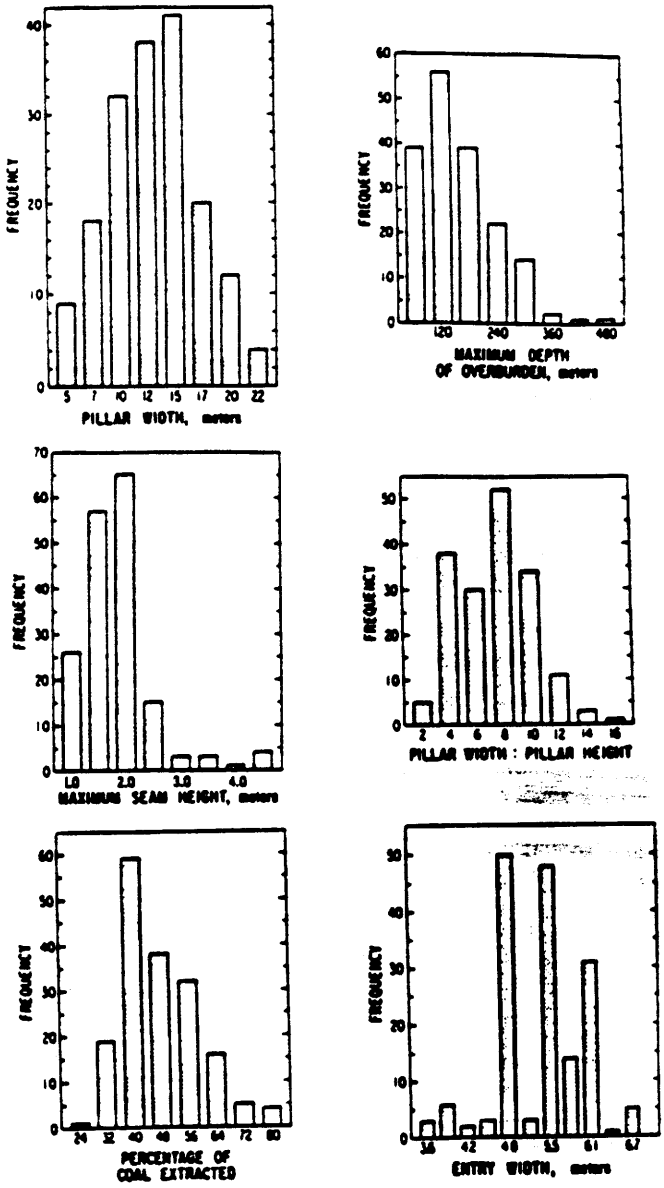


Fig. 10.5.17. Results of survey of room-and-pillar parameters in US coal mining (Bieniawski, 1984). Conversion factor: 1 ft = 0.3048 m.

two major ones are the tributary area approach and the elastic deflection theory.

The simplest approach to determine the pillar load is by the tributary area theory. If a number of well-known simplifying assumptions are made, the pillar load can be calculated from:

$$S_p = \frac{1.1\,H\,(w + B)\,(L + B)}{w \times L} \qquad (10.5.31)$$

where S_p is pillar load or the average pillar stress in psi, H is depth below surface in ft, w is pillar width in ft, L is pillar length in ft, and B entry width in ft. The term 1.1 H can be replaced by the virgin vertical pressure S_v derived from the overburden weight above the seam γH, where γ is the unit weight of the overburden. The pressure can be considered to increase at a rate of 1.1 psi/ft of depth.

For square pillars, that is, when $w = L$, Eq. 10.5.31 becomes

$$S_p = 1.1H \frac{[w + B]^2}{w} \qquad (10.5.32)$$

If the term *extraction e* is introduced (100*e* is percentage extraction), which is defined as the ratio of the mined-out area to total area, then for rectangular pillars the extraction

$$e = 1 - \left[\frac{w}{w + B}\right]\left[\frac{L}{L + B}\right] \qquad (10.5.33)$$

Thus Eq. 10.5.31 may also be rewritten as:

$$S_p = \frac{1.1H}{1 - e} \qquad (10.5.34)$$

This approach incorporates the following assumptions:

1. The seam is subjected only to vertical pressure, which is constant over the mined area. However, stress transfer occurs where stiff abutments exist in underground workings. Thus this vertical pressure may be relieved partially.

2. Each pillar supports the column of rock over an area that is the sum of the cross-sectional area of the pillar plus a portion of the room area, the latter being equally shared by all neighboring pillars. However, this is certainly not valid if the area of development is small since the pillars in the center of the excavation are under more stress than the pillars near the sides. It is usually only accepted as valid if the mined-out area is greater than the depth below surface.

3. It is assumed that the load is uniformly distributed over the cross-sectional area of the pillar. However, research has shown that:

a) The stress is not evenly distributed over the cross section of an individual pillar, the maximum stress occurring at the corners formed by the intersection of three orthogonal planes, namely, two sidewalls of the pillar and the roof or the floor.

b) The stress on pillars increases with percentage extraction.

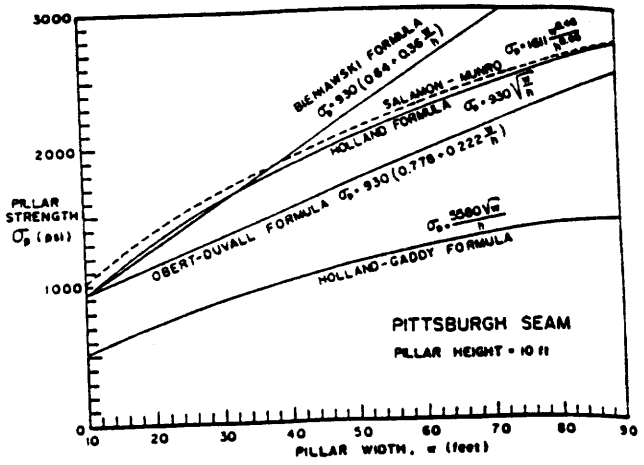
c) The stress distribution in pillars depends upon the ratio of pillar width to pillar height.

Clearly, the assumptions made in the formulation of this approach lead to a conservative estimate of the pillar load. Therefore, it represents the upper limit of the average pillar stress. In fact, measurements have shown (Hustrulid and Swanson, 1981) that this approach overestimates the pillar load by about 40%. The simplicity and conservatism of this approach results in its present popularity.

10.5.6.3 Comparisons of Pillar Strength Formulas

From all the available pillar strength formulas, five empirical expressions are most commonly used.

In Fig. 10.5.18, the five selected formulas are plotted (using the Pittsburgh coal seam properties) as the strength ratio vs. the width-to-height ratio. It is apparent from these figures that for higher width-to-height ratios, the Holland-Gaddy formula predicts the lowest strength while the Bieniawski formula predicts the highest strength. At the same time, the form of the Holland formula is such that it will become very conservative at large width-to-height ratios. The higher strength values predicted by the Bieniawski formula are consistent with the fact that for high width-to-height ratios, there is a very rapid strength increase. In fact, pillars are thought to be almost indestructible for width-to-height ratios greater than 10 (Cook and Hood, 1978).



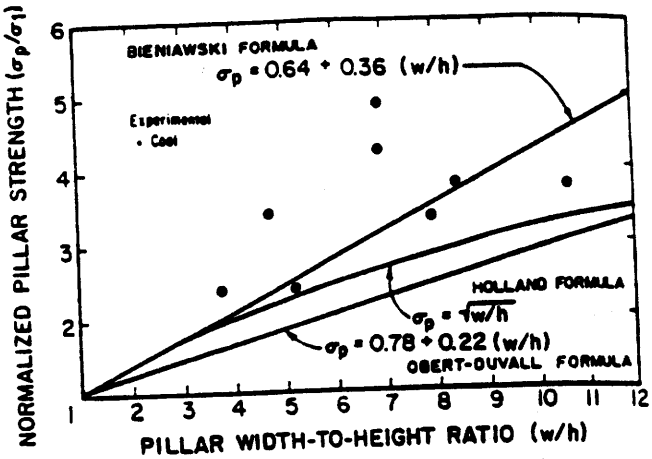


Fig. 10.5.18. Comparison of pillar strength formulas with respect to width-to-height ratio (Bieniawski, 1987). Conversion factor: 1 psi = 6.895 kPa.

A detailed study of this aspect (Bauer, 1980) revealed that the theoretical strength of coal pillars is considerably higher even than that predicted by the Bieniawski formula. Accordingly, it was proposed (Belesky, 1981) that an exponent could be added to the Bieniawski formula thus incorporating a higher rate of strength increase with increasing width-to-height ratios. Currently, the Salamon-Munro formula is being modified along this line (Madden, 1988).

In addition, it is also obvious from Fig. 10.5.18 that the Holland formula and Salamon and Munro formula are quite close in their predictions. This is not surprising since Salamon-Munro used the format of the Holland formula to derive their expression for the strength of coal pillars in South Africa. It is also evident that the Holland-Gaddy formula is very conservative by comparison with the original Holland formula as well as with the other three formulas.

An important point of consideration when comparing pillar strength formulas is the value of the recommended factor of safety, which varies for different formulas. This is demonstrated in Ex. 10.5.3.

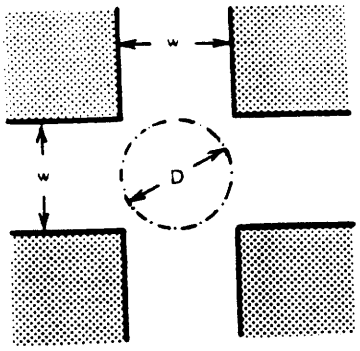
10.5.6.4 Design Procedure

The following step-by-step pillar design procedure is recommended (Bieniawski, 1984) when planning new room and pillar coal mines (equations identified):

APPENDIX #2

. CHIMNEY CAVING - B.N. WHITTAKER (Pg. 192 - 196)
. CHIMNEY CAVING HEIGHT CALCULATION - WHITTAKER
. CHIMNEY CAVE HEIGHT CALCULATION - PARISEAU

Basic symbols relating to mine junctions

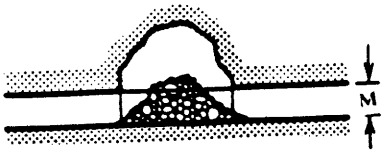


Chimney diameter assumptions

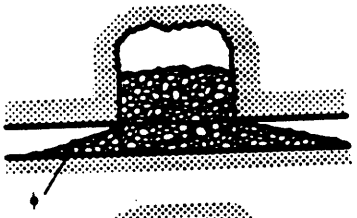
(a) $D = w$

(b) $D = w\sqrt{2}$

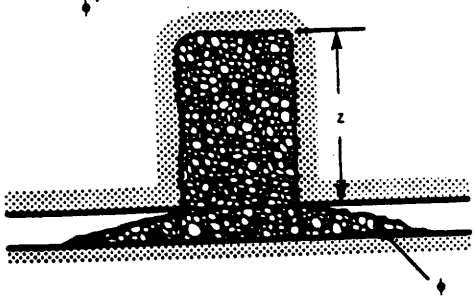
Development of caving above junction



1. Initial collapse condition of mine junction.



2. Progressive development of roof collapse with caved rock spilling into adjoining rooms to roof level.



3. Caved rock fills remainder of chimney during self choking process.

Figure 113 Basic considerations in development of caving above 4-way junction

The initial collapse of the mine juction leads to caved rock spilling into the adjoining rooms forming an angle of repose (ϕ). On reaching roof level, the caved material fills the remainder of the collapse-chimney by virtue of its natural bulking characteristics.

$$V_{caved} = k\, z\, \pi D^2/4 \qquad (57)$$

$$V_{space} = 4(\tfrac{1}{2} w M^2 \cot\phi) + M w^2 + z \pi D^2/4 \qquad (58)$$

ameter assumptions

Equating (57) and (58)

$$z = \frac{4}{(k-1)\pi D^2}\left\{2 w M^2 \cot\phi + M w^2\right\} \qquad ...(59)$$

) = w

) = w√2

where, V_{caved} = volume of caved rock from collapse-chimney

V_{space} = volume of available space to receive caved roof rock

k = bulking factor, considered to be in the range 1·33 to 1·5

z = height of collapse-chimney

D = diameter of collapse-chimney

w = width of mine rooms

M = excavated height of mine rooms

ϕ = angle of repose of caved rock within mine rooms adjoining collapse area.

ıal collapse condition of
ıe junction.

In equations (57) and (58), the rock density in its solid state is assumed to remain uniform and the bulking characteristics are also assumed to be consistent and remain unaffected by loading created during the extension in height of the collapse-chimney. It is considered that the increased loading on broken material at the base of the chimney will produce insignificant change in volume during the process of caving to the full height of the chimney.

ıgressive development of roof
lapse with caved rock spilling
ɔ adjoining rooms to roof
el.

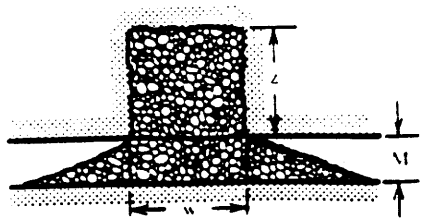
The diameter of the chimney has been observed by the authors to be generally in the range of D = w and D = w√2.

Figure 114 shows data plotted for a practical range of room width (w) using equation (59). Considering room widths to be in the range of 4 - 8m, the maximum height (z) of the collapse chimney is indicated to be in the range 3 - 9 (extraction height). The height of extraction used in this example is 3m and corresponds to a common operating height. Figure 114 suggests that narrow rooms could result in an increased height of caving, but this must be considered in relation to the fact that a narrower room is less likely to collapse. The most common room width in coal and most other stratified mineral deposit room and pillar mines is 6m, and Figure 114 indicates a caving height of 3·5 - 7M (extraction height).

ved rock fills remainder of
mney during self choking
ɔcess.

Figure 115 shows graphical representations of some of the important variables influencing the height of the collapse chimney. Figure 115(a) indicates that the caving height (as a multiple of M) increases appreciably with increasing extracted mine room height. The collapse-chimney diameter (D) is seen to be a significant factor regarding the projected height (z) of the caving.

ıove 4-way junction



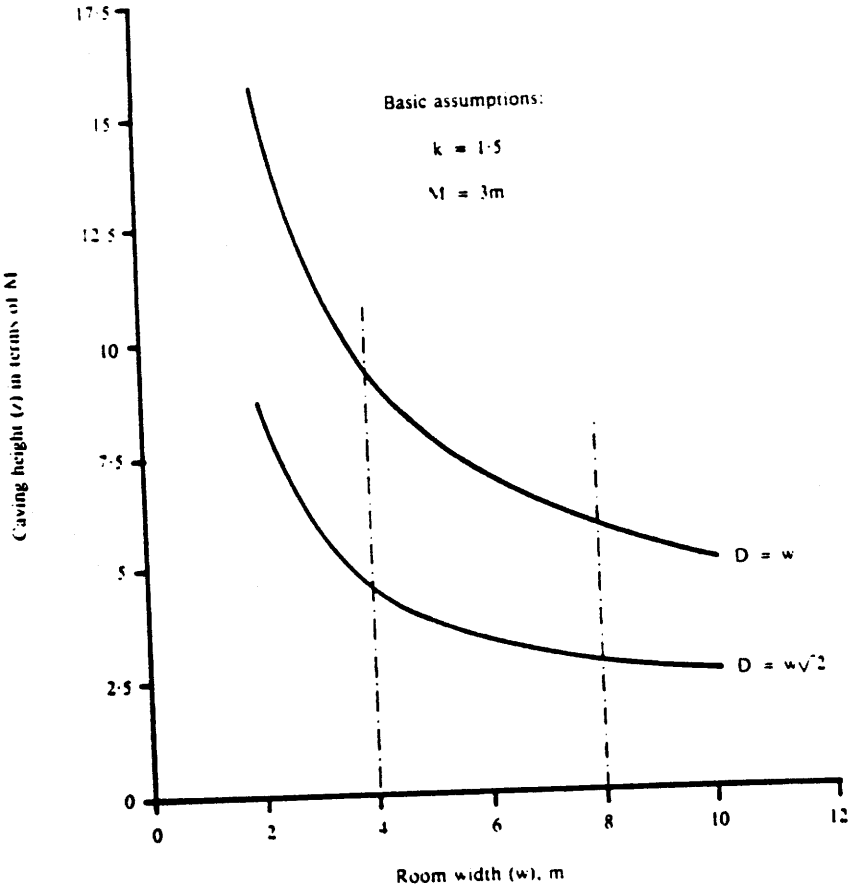
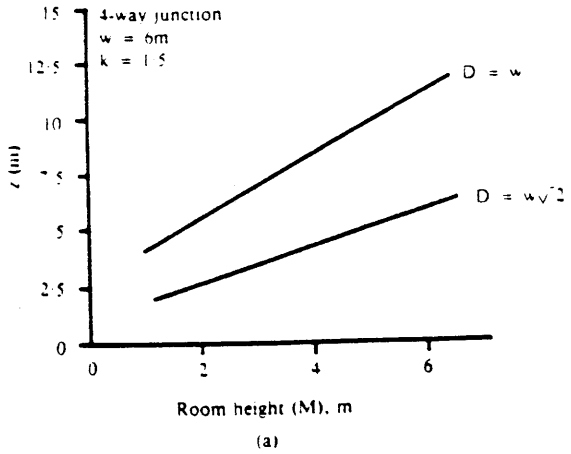
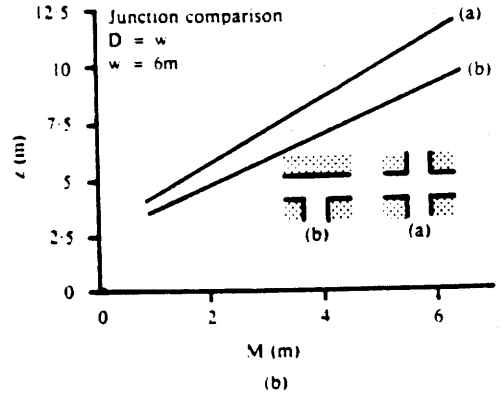


Figure 114 Relationship between caving height and room width for 4-way junction





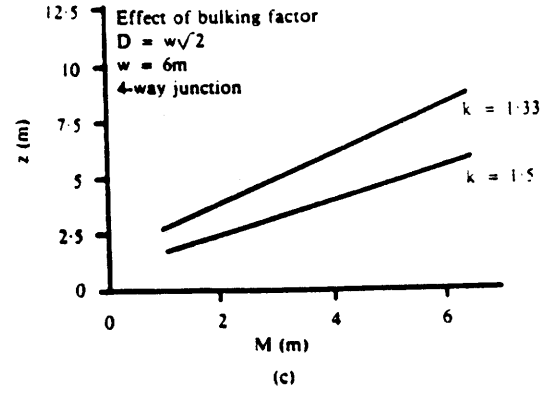


Figure 115. Influence of room height (M) on height of caving (z)

Figure 115(b) shows as would be expected that the 3-way mine room junction decreases the projected caving height by an appreciable amount by comparison with the 4-way type of junction, especially in those mines employing room heights greater than 3m.

The bulking factor (k) has the greatest influence of any of the variables and this is demonstrated in Figure 115(c). The diagram compares two values of k; for k = 1·5 this is regarded as a realistic value whilst for k = 1·33 this is considered as an extreme value which could be encountered in certain geological conditions where minor breakage occurs as with strong rocks.

Comparison of Figures 114 and 115 indicates that assessment of the height of caving should take into account the mining dimensions of the rooms, type of geology and bulking characteristics of the immediate roof strata. However, on the basis of the assessment carried out here it would appear that a caving height 4 - 10 (M) might occur but with increased likelihood of a height up to 7M being more probable. This assessment does not take into consideration the possibility of water causing the chimney of caved rock to flow into the mine.

Influence of Overlying Aquifer on Development of Collapse-Chimney Towards Surface

If a collapsed mine junction allows the development of caving and formation of a subsidence chimney which intersects an overlying aquifer as demonstrated in Figure 116, then there is a strong possibility of wet caved material flowing into the mine. Encountering an aquifer can lead to caved clays and mudstone softening and forming material of the consistency of mud which can tend to seal the chimney in some instances; this can promote a build-up of a head of water within the chimney and the resultant effective pressure at the seal may cause sudden release and discharge of the wet caved rocks and mud into adjoining rooms.

Consequently, the caving process within the chimney can then proceed to heights well in excess of those predicted in the previous section. For example in UK stratified ironstone room and pillar mining operations at a depth of 100m and room height and width of 6m, sink-holes have appeared at the suface after 3 - 10 years since the original junctions collapsed, but only in direct association with water from an overlying aquifer which prevented natural choking by bulking of the caved roof rocks.

Where collapsed junctions have posed a significant risk to a sink-hole appearing at the surface by virtue of intersecting an overlying aquifer, then in the case of an operating mine suitable walls have been constructed to dam the collapsed area on all sides. This preventative measure has been highly successful. In exceptional circumstances where a chimney was known to be approaching important properties at the surface, drilling from the surface has been carried out to tap the cavity and fill it with suitable material in order to arrest its upward movement.

Instrumentation involving strain wires and plugs located in a borehole over a subsidence chimney approaching the surface, has been employed as a control measure; strain wire readings using an extensometer device have been made at the surface in such situations. Such readings have allowed progress of upward movement of the chimney to be observed.

Figure 117 shows diagrammatically an instrumentation scheme which has been used over collapsed mine junctions in order to observe whether further instability is taking place which could result in a sink-hole appearing at the surface. Anchor plugs are secured at selected horizons within a borehole and attached strain wires are brought out to the surface where they

CHIMNEY CAVING HEIGHT (after Whittaker, 1989, pg. 192-196)

$$V_{CAVED} = k\ z\ \pi\ D^2 / 4 \quad (1)$$

$$V_{SPACE} = 4\,(1/2\ w\ M^2 \cot \Phi) + Mw^2 + z\ \pi\ D^2/4 \quad (2)$$

Equating (1) and (2):

$$z = 4 / (k - 1)\ \pi\ D^2\ [2\ w\ M^2 \cot \Phi + M\ w^2]$$

where: V_{CAVED} = Volume of caved rock from chimney collapse

V_{SPACE} = Volume of available space to receive caved roof rock

k = Bulking factor [considered to be in the range of 1.20 to 1.55]

z = Height of collapse [chimney cave]

D = Diameter of collapse [chimney cave]

w = Width of mine rooms

M = Excavated height of mine rooms

Φ = Angle of repose

Assumptions:

The cave is assumed to occur in a 4-way entry intersection (worst case scenario);

where: k = 1.20 (conservative)

$D = w\sqrt{2}$

w = 20 ft.

M = 8.5 ft.

$\Phi = 30^\circ$

Calculation: z = 134 ft.

CHIMNEY CAVING HEIGHT (after Pariseau, 1993)

$$\beta = V_v / V_v + V_s$$

$$\beta = V_v / V_t$$

where: β = Bulking porosity (assumed to be in the range of .001 to 0.33)

V_v = Void volume

V_s = Solids volume

V_t = Total volume

Assumptions:

It is assumed that the 60ft. x 110 ft. pillar is nonexistent. Thus, the width of the presumed cave is 100 ft. , the length is 150 ft., and the height is 8.5 ft.

where: β = 0.1

V_v = 100 x 150 x 8.5 = 127,500 ft^3

V_s = 100 x 150 x H = 15,000H ft^3

Calculation:

where: $\beta = V_v / V_v +$ W x L x H

H = 76.5 ft. (Overall cave height)

APPENDIX #3

. LITHOLOGIC LOG - DRILL HOLE EM - 166
RILDA CANYON / MILL FORK (SHEETS 1 - 7)

N. 596,726.93
E. 2,091,795.32

PAGE 1 OF 7

COAL LITHOLOGIC LOG
ENERGY WEST MINING COMPANY

PROJECT: RILDA - MILL FORK DRILLING DRILL HOLE: EM-166 FIELD LOG

LOCATION: RILDA CANYON
COLLAR ELEV.: 8511.63
HOLE TYPE: CORE
PLUG INTERVAL: —
CORE INTERVAL: 0 - 589
TOTAL DEPTH: 589'
DATE: 7/10/00 - 7/14/00
SCALE: 1" = 10'
GEOLOGIST: K.S. FLECK

GEOPHYSICAL DATA

LOG	FROM	TO
DENSITY:	38 325	555
H.R.D.:		
E. LOG:		
GAMMA:	0	560
CALIPER:		
S.P.:		

COAL SUMMARY:

SEAM	THICKNESS	INT.
B.C.	6.1	55.2
HIA	8.5	

DEPTH	PLUG	CORE	GRAPHIC LOG	FORMATION NAME	LITHOLOGIC DESCRIPTION	R.Q.D.	BOX NO.	RUN NO.	% REC.
0					0-18 ALLUVIUM MOSTLY SOIL			1	
10								2	0
20					18-28' SANDSTONE (BOULDER) STEEPLY INCLINED BEDDING		1	3	4.1'
30					28-38 RUBBLE, NEW SS ROCKS, V. WEATH.			4	0.2
40					38-48 MUDSTONE, HIGHLY FRACTURED + WEATHERED FOSSILS			5	3.8
50					48-50 MUD/MUDSTONE, WEATH, SOFT, V. STICKY			6	0.2
					50-57.8 MUDSTONE, SILTY, FRAC, WEATH. V. FRAC + WEATH 50-53.4 VERT + OBLIQUE FRACT		57.4 2	7	7.2
60					57.8-59 CMS/COAL, V. SOFT V. MATX				0.
					59-60.6 SILTSTONE, MUDDY, VERT. WEATH. FRAC		60.6	9	9.2
					60.6-64 SANDSTONE, BUFF, BOTT. 0.3' OF RUN FLOOR SL. BURNED TOP 0.4 OF RUN 10			62	
					64-65.5 MUD + RUBBLE, V. WEATH, SOFT		3	60 64	2.5
					65.5-66.1 MUDSTONE			11	0.3
					66.1-67.3 RUBBLE, BRITTLE, LOOKS BURNED			67	0.3
					67.3-69.0 MUDSTONE			68	1.2
70					69.0-77 SILTSTONE, MUDDY, WEATH		69.0 4	16	

COAL LITHOLOGIC LOG
ENERGY WEST MINING COMPANY

PROJECT: RILDA-MILLER
DRILL HOLE: EM-166
PAGE 2 OF 7

DEPTH	PLUG	CORE	GRAPHIC LOG	FORMATION NAME	LITHOLOGIC DESCRIPTION	R.Q.D.	BOX NO.	RUN NO.	% REC.	SAMPLE
70					72-86.9 MS/SLST. INT V. SLIGHT. WEATH.		4	16	6.0	
								74		
								17	3.9'	
							79.1	78.5		
80							5	18	10	
					86.9-90 SANDSTONE, F.G., W/10% MS INT. STRONGLY STAINED		89	89		
90					90-91.5 SANDSTONE, A.A. W/SLST. INT. NOT WEATH.					
					91.5-94.0 SANDSTONE, A.A. STRONGLY STAINED.					
					94.0-96.0 MUDSTONE, SILTY, COALY & BOTTOM, SL. WEATH		6	19	8.0	
					96.0-104 SS, VFG., MS INT, THICK BEDS NOT WEATH.			99		
100							100.9			
					104-108 MUDSTONE DK GRAY, NOT WEATH		7	20	8.0	
								108		
110					108-115.5 SILTSTONE, W/OCC. MS INT, NOT WEATH		111.3			
								21	5.0	
					115.5-116.0 MS/CMS BLACK, FOSS., PLATY			116		
					116- 124.5 SILTSTONE/MUDSTONE INT. OCC. WEATH. BLOTCHES		8	22	10.2	
120							124	125		
					124.5-130 MUDSTONE, DARK, LIGHTER TONED BOTTOM		9	23	8	
							132.5			
130					130.0-138.5 SILTSTONE LIGHT, HA VERT FRAC. @ TOP 1'			135		
								24	7.4	
					138.5-148.5 SANDSTONE, VFG., STRONG STAINING		10	145		
140							146			
								25	8.5	
150			COAL		148.5-152 COAL, BRIGHT, RESINOUS		11	157		
					152.0- SANDSTONE/MUDSTONE INT., NOT WEATH		155			
								26	8.8	
160							12	160		
							164			

COAL LITHOLOGIC LOG
ENERGY WEST MINING COMPANY

PROJECT: RILDA
DRILL HOLE: EM-166

DEPTH	PLUG	CORE	GRAPHIC LOG	FORMATION NAME	LITHOLOGIC DESCRIPTION	R.Q.D.	BOX NO.	RUN NO.	% REC.	SAMPLE
160					SS/MS INT., GRADES TO MS/CMS BELOW.		12	27		
							164	166		
170					168 - 169 CMS/COAL					
					169 - 177 SANDSTONE, F-FRAC, STRONGLY WEATH.		13	28	9.1	
							179.5	176		
					177 - 181 MUDSTONE, GRADES DOWN INTO CMS/COAL BOTT. 1.5					
180							14	29	11	
					181 - 184 SILTSTONE/SS VFG, HA WHITE					
					184 - 197 MUDSTONE, OCC. CMS/COAL INT GRADES DOWN INTO SLST.		185	185		
190							15	30	7.2	
							192.5	192.5		
								31	2.5	
								196		
					197 - 204? SANDSTONE, MOSTLY WEATH.		16	32	6	
200								204		
					204 - 204.3 COAL/CMS		205			
					204.3 - 218.5 MS, DK, SILTY			33	6	
							17	213		
									6.3	
210							217.5	218		
					218.5 - 219 SS, FINING DOWNWARD INTO ↓					
					219 - 245 MS/SS INTERBEDS, V. F.G. SANDIER TOWARD BOTT.		18		8.5	
220							224	225	225	
							19			
							233.2		12.7	
230								238		
							20		(3)	
							243.8	241.6		
240									22.4	
									(7.4)	
					245 - 250 SANDSTONE, W/MS INT.					
250								250	250	

COAL LITHOLOGIC LOG
ENERGY WEST MINING COMPANY

PROJECT: RILDA
DRILL HOLE: EM-166
PAGE 4 OF 7

DEPTH	PLUG	CORE	GRAPHIC LOG	FORMATION NAME	LITHOLOGIC DESCRIPTION	R.Q.D.	BOX NO.	RUN NO.	% REC.	SAMPLE
250					250 - 258 SANDSTONE, VFG, MASSIVE BECOMES COALY @ BOTTOM		21			
							254.2		10.9	
							22	258		
260					258 - 267 MUDSTONE, DARK, HARD GRADES DOWNWARD INTO SLST/SS		261.5		3.2+ 10.2	
							23	268		
270					267-277 MUDSTONE, DARK, HARD GRADES DOWNWARD TO SLST/MS INT.		276		9	
							24	277		
280					277 - 283 SS, LT, F.G, W/MS INT. BIOTURB.		283		10	
					283 - 291.5 SANDSTONE, F.G., OCC. COAL INT.			287		
290							25		8.9	
					291.5 294 MS, SLICKS, OCC. CMS INT.		289	295		
					294 - 302 MS/SLST. INT		26		6	
300								301		
					302 - 308.6 MS/CMS DK, OCC. PLATY		303		7.4	
							27	308		
310					308.6 - 322.2 SS, VFG, W/OCC MS + COAL STKS				2.6+	
							312.6		8.6	
							28	318		
320							322		4+ 10.4	
					322.2 - 328.5 MS, DK, OCC. CMS/COAL INT.					
							29	328		
					328.5 - 330 SILTSTONE, LIGHT, HARD				+3.6	
330					330 - 331 MUDSTONE SILTY		330.6			
					331 - 332.5 SS, VFG W/ABDT COAL LAMS				10.3	
					332.5 - 350.9 MS, SILTY, W/OCC. SS + CMS INT.		30			
								338	+2.9	
340										

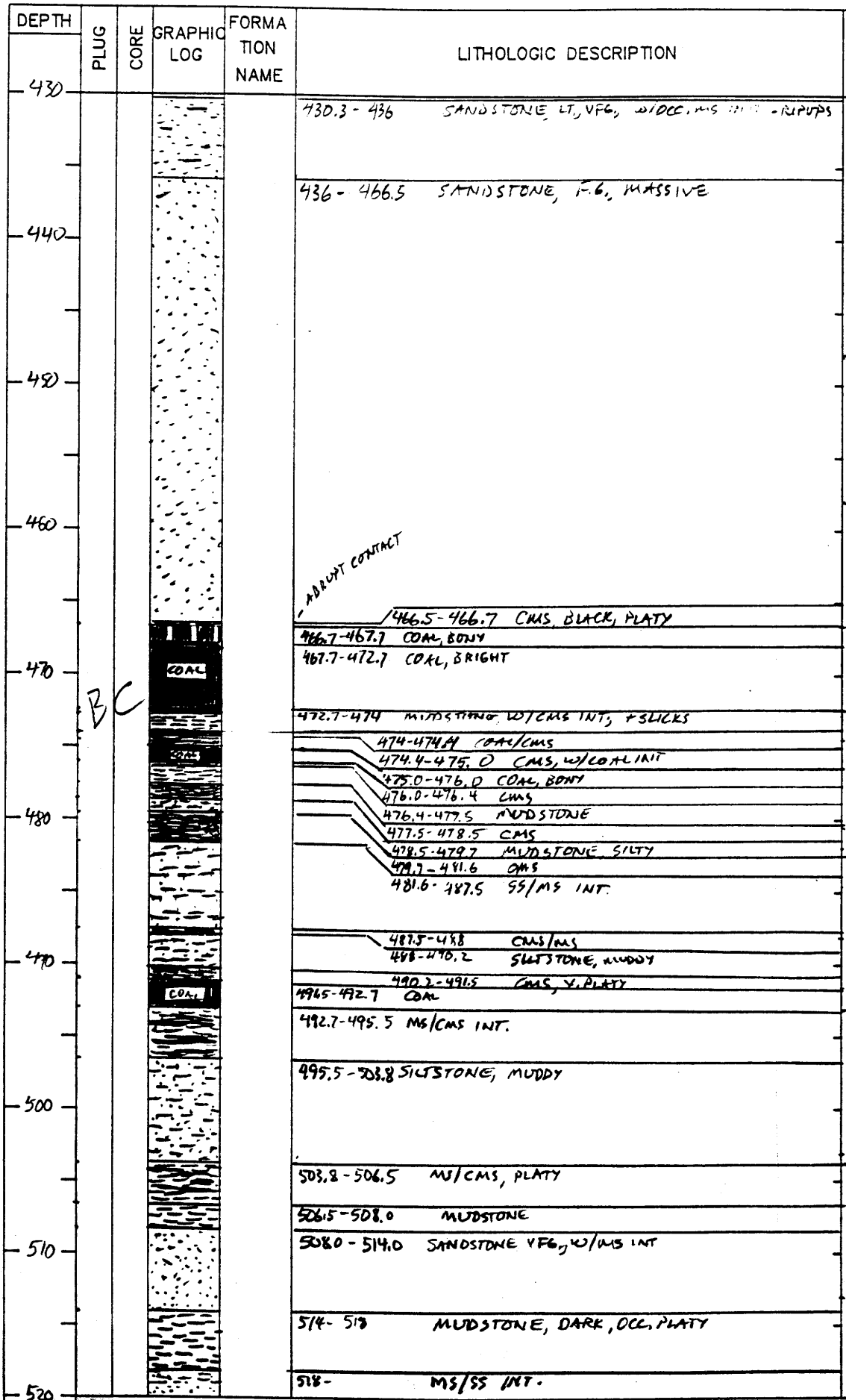
COAL LITHOLOGIC LOG
ENERGY WEST MINING COMPANY

PROJECT: RILDA
DRILL HOLE: EM1-166

DEPTH	PLUG	CORE	GRAPHIC LOG	FORMATION NAME	LITHOLOGIC DESCRIPTION	R.Q.D.	BOX NO.	RUN NO.	% REC.	SAMPLE
340					MS, SILTY W/OCC. SS+CMS INT.		30 340.8	-2.8		
							31		10.6	
								348		
350					350.9 - 351.3 COAL, THIN CMS BANDS		350.1	2.1		
					351.3 - 354 MUDSTONE, SILTY, W/CMS + SMALL COAL STRINGERS					
					354.0 - 361 SILTSTONE, LIGHT, HARD, GRADES DOWN INTO DARK MS		32		10	
								358		
360							360.1			
					361 - 380.3 SANDSTONE, VFG W LAMS OF MS+SS.		33		10	
								368		
370							369.6			
							34	10	10.2	
								378		
380							379			
					380.3 - 381.7 COAL/CMS CMS MIDDLE 0.9'					
					381.7 - MUDSTONE, SILTY		35		10	
								388		
390							388.9			
							36		10	
								398		
400							37		10	
							408	408		
410							38		10	
							417			
								418		
420					421 - 421.5 COAL			+28		
					4215 - 423 MUDSTONE, DARK		39		10	
					423 - 430.3 SILTSTONE, W/OCC. SS+MS INT; MD		429.8			
								428		
								+6.6		
430							40			

COAL LITHOLOGIC LOG
ENERGY WEST MINING COMPANY

PROJECT: IRILDA
DRILL HOLE: EM-166
PAGE 6 OF 7



COAL LITHOLOGIC LOG
ENERGY WEST MINING COMPANY

PROJECT: RILDA
DRILL HOLE: EM-166
PAGE 7 OF 7

DEPTH	PLUG	CORE	GRAPHIC LOG	FORMATION NAME	LITHOLOGIC DESCRIPTION	R.Q.D.	BOX NO.	RUN NO.	% REC.	SAMPLE
520							50	523 +5		
							528			528.1
530		6.6' THICK (206)	COAL		528.1 - 536.3 COAL, HIA BROKEN UP CORE 8.2' THICK IN BOX				10	1 536.1
										2 533.1
							51	534		3 538.1
										4 536.3
					536.3 - 536.5 COAL/CMS 536.5 - SANDSTONE, FG, STRATT.		538		16	
540							52	544		
							543.3			
									10	
550							53			
								554		
							556.5			
									10	
560							54			
								565		
							566.5			
									10	
570							55			
								575		
							576.5			
									6	
580							56	581		
							585.5		8	
							57			
590							589	585		
			589 T.D.							
					SEALED HOLE W/ 26 SACKS CEMENT 1 2 3 4 BATCHES 100 GAL @ 600 FT ×.37 G/FT STARTING W/FIRST @ 540 440 GAL / 26 SACKS ≈ 6 SACKS / 100 GAL 4200 18000 22200					
600					SURF. PLUG. 1 SACK 6 SACKS BENTONITE DON STEPHENS 636-3608					

536.3 - 528.0 = 8.3

544.2 - 3.6 = 541.4

WATER BURDEN
EM-164 32.7
EM-56 c 66.1
EM-166 52.0

528.0 - 476.0 = 52.0