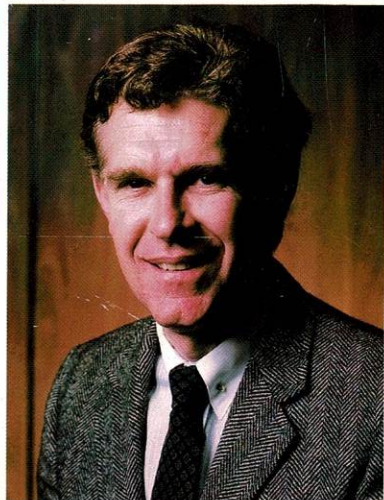


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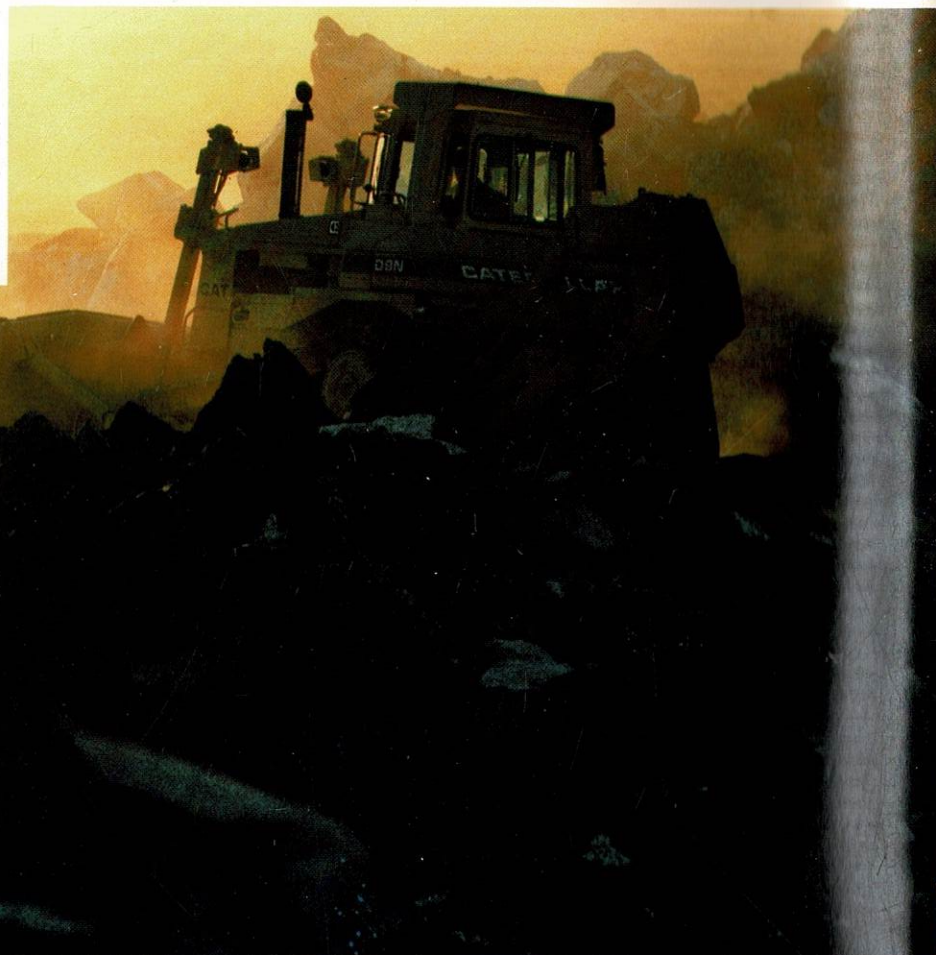
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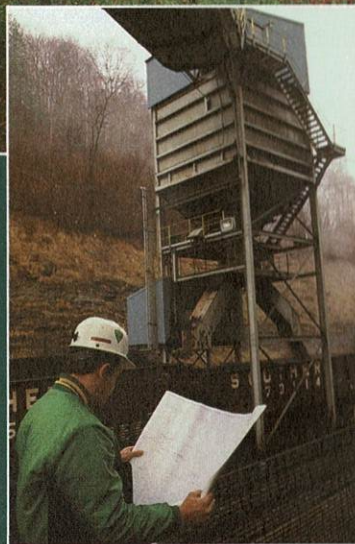
# Green Lands

Winter 1990





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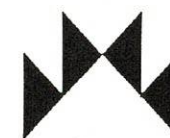
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## Green Lands

is a quarterly publication of the  
West Virginia Mining & Reclamation Association,  
with offices at 1624 Kanawha Boulevard East  
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## Our Cover

Green Mountain Co. worked around  
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West Virginia AML sites in our cover story,  
beginning on page 19.

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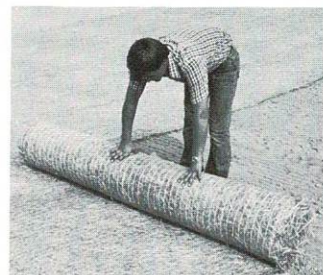


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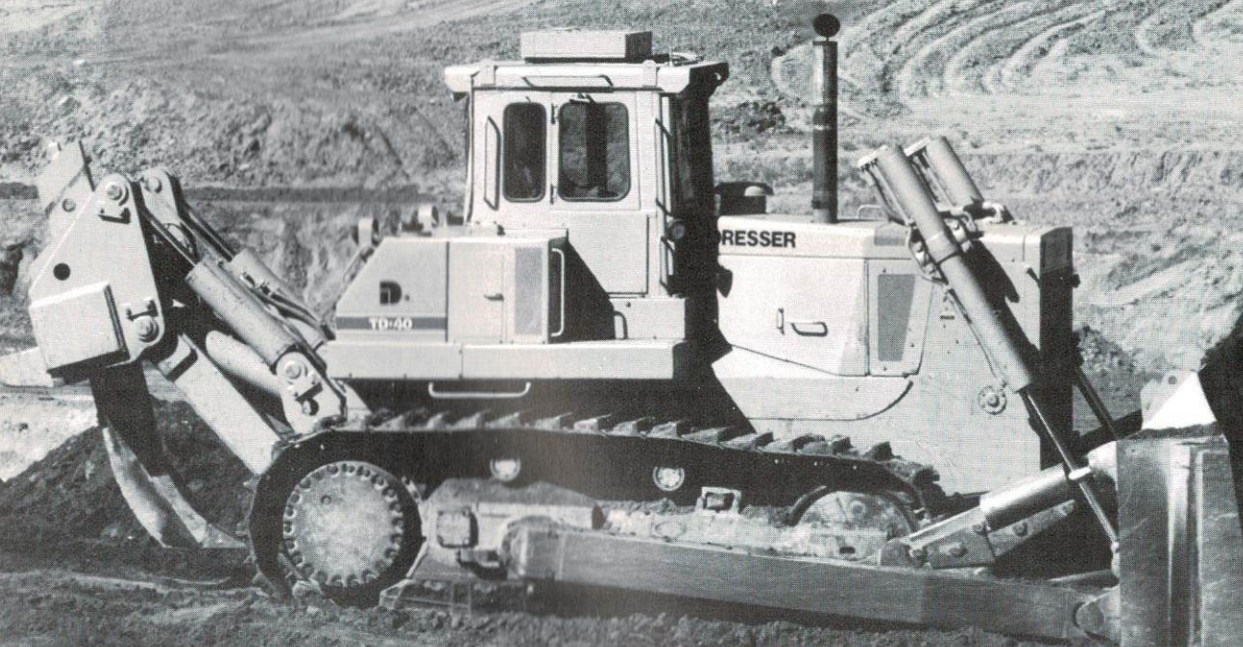
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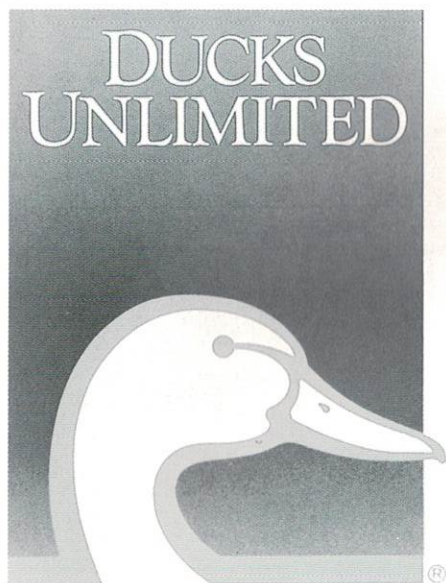
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## WVMRA signs wetlands pact with Ducks Unlimited

WVMRA has signed an unprecedented agreement with Ducks Unlimited, Inc. with the objective of creating wetland habitat for waterfowl and other wildlife species through the reclamation of mined land throughout West Virginia.

The signing ceremony took place January 12 during the West Virginia Mining Symposium in Charleston.

This is the first statewide agreement in the nation between the mining industry and the well-known conservationist organization.

Under terms of the Memorandum of Understanding, Ducks Unlimited will provide biological expertise to Association members in their mine reclamation activities.

In turn, WVMRA will "promote and encourage the design, construction, and maintenance of wetland habitat" in the course of the reclamation process.

"This agreement represents an important first step toward the creation and restoration of thousands of acres of vitally important wetland habitat in the Atlantic Flyway, and we are very enthusiastic about having the opportunity to work with the mining industry in this effort," said Matthew B. Connolly, Jr., DU's executive vice president.

"Not only does it provide for the establishment of critical habitat to benefit wildlife, but it also provides a viable, environmentally sound method for the reclamation of mining lands. Such cooperative ventures between conservation groups and representatives of other sectors are essential if we are to succeed in stemming the loss of North American wetlands."

Some 12,000-15,000 acres of recently mined land are reclaimed annually in West Virginia, and an additional 2,000-3,000 acres are reclaimed

each year through the industry funded Abandoned Mine Lands program.

The industry in West Virginia has paid over \$300 million into the AML fund since its inception in 1977. "All of this," according to Association President Ben Greene, "makes West Virginia's reclamation effort the most intensive in the nation. This agreement is a logical extension of the commitment we have traditionally made to the environment."

Office of Surface Mining Director Harry M. Snyder, in town for the signing ceremony and the closing luncheon of the Symposium, also lauded the agreement, calling it "a significant step toward the achievement of President Bush's promise of 'no net loss of wetlands' during his administration. We hope that OSM can be as successful in generating this type of agreement as DU and WVMRA have been. I applaud both groups."



A diverse group lent their time and support to the Memorandum of Understanding between WVMRA and Ducks Unlimited. From left to right are WVMRA President Ben Greene, WVMRA Board Chairman Paul Hutchins, West Virginia DoE Commissioner George Dials, West Virginia DNR Director Ed Hamrick, West Virginia Delegate Sam Love, OSM Director Harry Snyder, DU Director of Federal Liaison John Smolko, DU West Virginia Major Donor Chairman Sandy Latimer, DU West Virginia State Chairman Michael Hoeft, and DU Regional Vice President Larry Leese.

## Ducks Unlimited - A tradition of conservation

Ducks Unlimited was founded in 1937, when the Dust Bowl conditions of the Great Depression brought waterfowl populations in North America to an all time low.

From a modest beginning of some 6,700 supporters with \$90,000, DU has grown to be the world's largest private sector wetlands and waterfowl conservation organization.

Current membership stands at over 500,000 members who have raised more than a half-billion dollars to implement the conservation of 5.3 million acres throughout North America. More than 4,800 wetland projects have been constructed to the benefit of some 600 wildlife species.

DU concentrated its first efforts in Canada, addressing the need for protected upland breeding and nesting

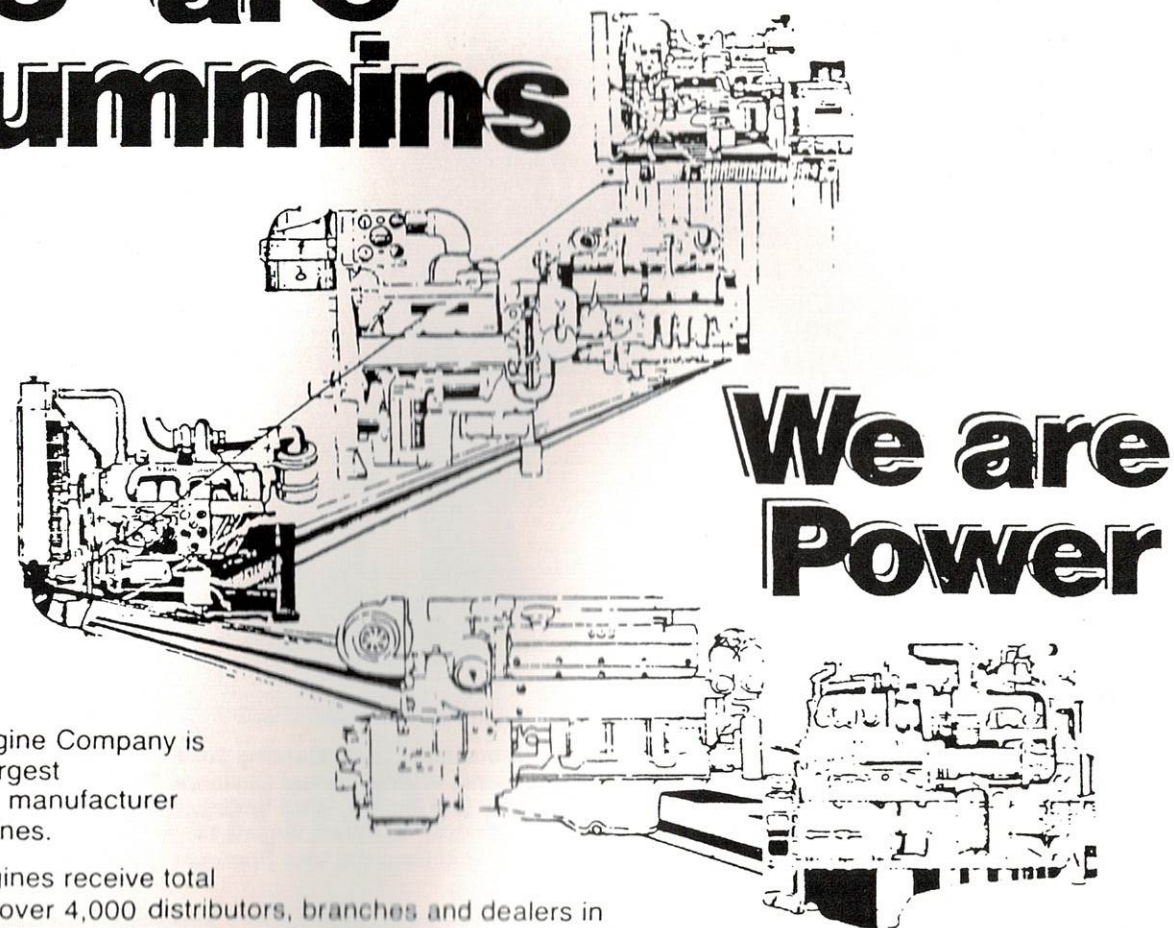
sites and shallow brood-rearing ponds. In the 1970's, the organization turned its attention to Mexico, in order to secure wintering habitat. In the 1980's, DU began wetland construction in the U.S. to provide waterfowl with wintering grounds and stopover sites along the migration corridors. There are now active DU projects in all 50 states.

Today, DU is the acknowledged leader in wetlands conservation and construction. Altogether, more than 600 species of waterfowl and other wildlife benefit from DU's 4,800 plus projects, and its management of more than five million acres.

For membership information, contact Ducks Unlimited, One Waterfowl Way, Long Grove, IL 60047, (708) 438-4300.



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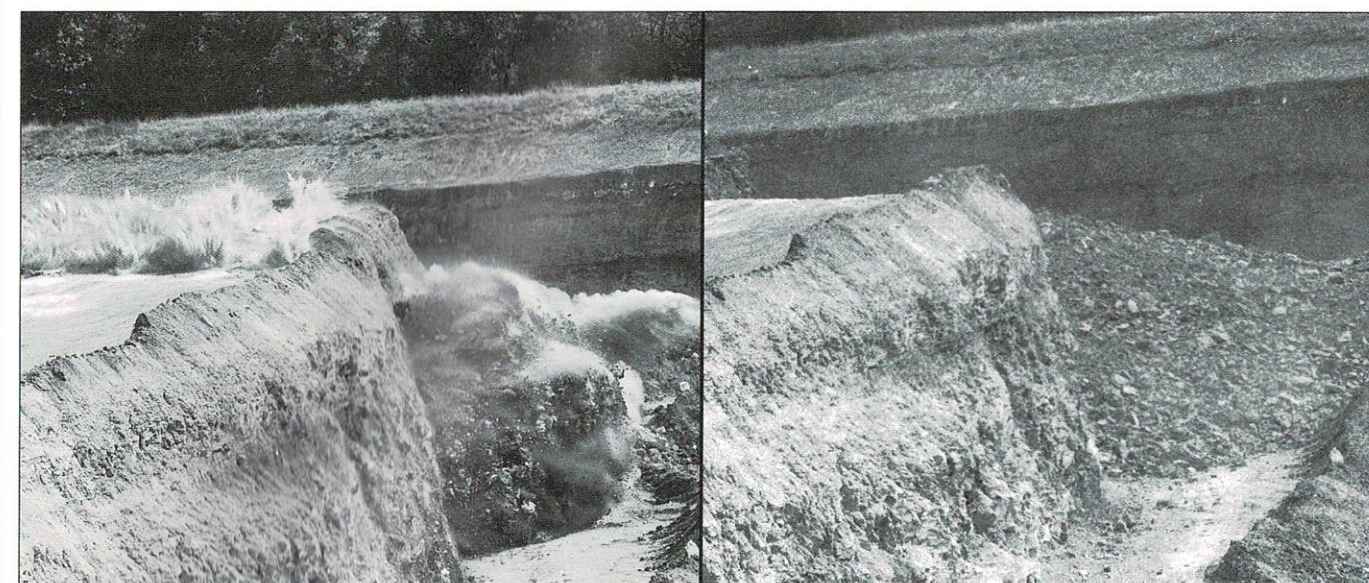
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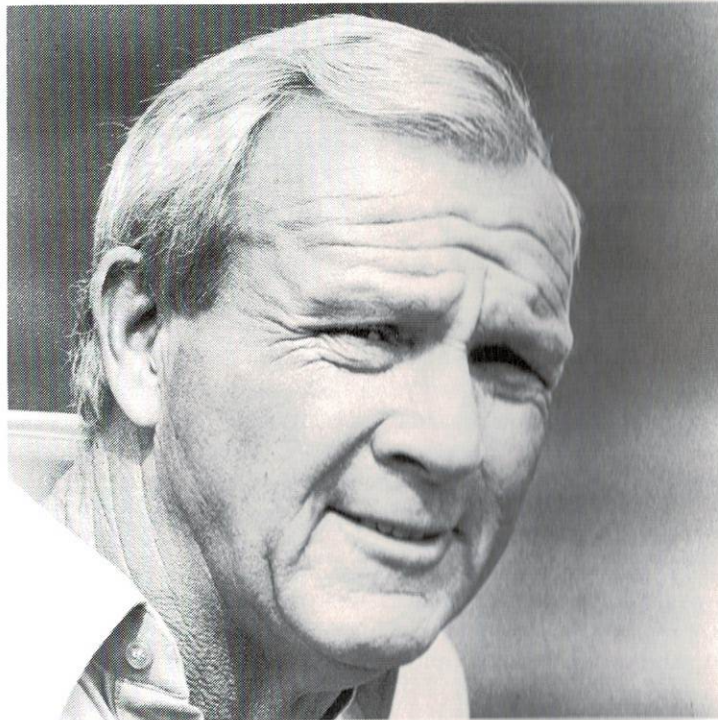
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*cost our economy 300 billion dollars. The Iranian oil shutdown of 1979 caused shortages that cost our economy alone a half trillion dollars. But today, our dependence on foreign energy is again accelerating too fast and we're getting hooked on the same unstable sources that brought us our 1970s shortages. We can cut our energy risks only by developing and using our own abundant energy resources; otherwise, we could again lose the ball on energy supply in the world's largest sand trap—the troublesome Middle East."*

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## Three functions in one

# Charleston will host major coal meeting

Charleston will host three major mining events in one this April.

Billed as "The 1990 Mining and Reclamation Conference," the event combines two annual conferences with a special exhibition.

The American Society for Surface Mining and Reclamation, a national organization which shifts its annual meeting from east to west each year, planned its 1990 conference for Charleston.

The West Virginia Surface Mine Drainage Task Force conducts an annual symposium, usually in Morgantown. It was decided to move that event to Charleston to coordinate it with the ASSMR gathering.

Then *Coal* magazine and Industrial Presentations proposed that their "Appalachian Surface Mining and Reclamation Exhibition" be held in conjunction with the other meetings.

Thus, Conference Chairman Dr. Jeff Skousen of West Virginia University was able to announce one of the largest and most extensive coal-related gatherings ever held in West Virginia. "This agreement, I think, will benefit all parties," Skousen commented. "The overall conference has been strengthened with a broader program and a greater number of exhibitors. Of course, the real winners in this arrangement will be those who attend the conference."

The three-day meeting (April 24-26) has the backing of a wide range of coal-related organizations from industry, government and education. This list of sponsors includes ASSMR, the West Virginia Surface Mine Drainage Task Force, the National Mine Land Reclamation Center, West Virginia University, WVMRA, *Coal People* magazine, the federal Office of Surface Mining, the U.S. Bureau of Mines, *Coal* magazine, and Industrial Presentations.

### Technical Sessions

The tentative program includes 23 separate sessions, roughly divided into two primary areas. One is "Applied Technology and Research," which will cover acid mine drainage, reclamation for improved land use, abandoned mine lands (general), wetlands (general), ecology of disturbed areas, revegetation (general), reclamation policy issues, overburden analytical work, postmining land use, abandoned mine land revegetation, wetlands (U.S. Bureau of Mines), minesoil productivity, forestry, and mining, reclamation and the media. With one exception, all papers presented in these sessions will be published in a "Pro-

ceedings," and will be distributed to each registrant at the beginning of the conference.

The papers presented at the special session entitled "Ecology of Disturbed Areas," will be published by the U.S. Forest Service at a later date.

The other major area, organized by *Coal* magazine, is that of "Mining Operations." Included in these sessions will be mountaintop mining, highwall mining, loader and dozer maintenance, a coal export workshop, contour mining, blasting, and regulatory issues. These papers will be published separately and made available to participants at a minimal cost from the *Coal* magazine/Exhibition registration desk.

### Field Trips

A six-day pre-conference field trip is planned, in addition to three one-day post-conference tours.

The six-day trip will begin in Knoxville, TN on Wednesday, April 18, with stops in North Carolina and Virginia, and concluding in Charleston on Monday. Tour stops will include active mining operations, AML sites, valley fill construction, mountaintop removal, revegetation of refuse, and research sites for overburden mixture, forest reestablishment, and composted sludge application.

On Friday, April 23, following the conference, a one-day tour is scheduled to Hobet Mining Co., near Madison, WV, for a discussion of reclamation and revegetation and a demonstration of overburden removal with Hobet's famed "Big John" dragline.

Two other one-day tours are being planned. One will visit an active AML site and one which has been completed. The other will emphasize acid mine drainage as well as chemical and biological methods to treat acid discharges.

### Exhibition

Exhibits will be handled by Industrial Presentations. There will be approximately 75-80 exhibitors set up in the Civic Center Coliseum, featuring mining equipment, mining and reclamation consultants, research and regulation agencies, and other mining related products and services.

Exhibit space is still available through Sam Posa, Industrial Presentations, Inc., 12371 E. Cornell Ave., Aurora, CO 80014, (303) 696-6100.

### Special Activities

An informal reception will open the conference on the evening of Monday, April 23.

## ASSMR - Task Force Symposium - Appalachian Exhibition

# The 1990 Mining & Reclamation Conference

On Tuesday, a special evening dinner and dancing cruise will be held on one of Charleston's local sternwheelers. The cost will be \$25.

The ASSMR Awards Luncheon will be held in the North Hall of the Civic Center at noon on Wednesday. West Virginia Congressman Nick Rahall and OSM Director Harry Snyder have been invited to speak. Awards for outstanding reclamationist, researcher, and special reclamationist will be presented. Cost of the luncheon is \$10.

A spouse's program will offer visits to the West Virginia State Capitol, as well as museums and other historic sites in the area.

### Accommodations and travel

The Charleston Marriott and the Holiday Inn-Civic Center, both conveniently located across the street from the conference site, have reserved blocks of rooms. Contact the Marriott at (304) 345-6500 and the Holiday Inn at (304) 345-0600. USAir will provide discounts of 5-35% on airfare to

Charleston. Arrangements may be made by calling 1-800-334-8644 and referring to "Gold File #495506."

### Registration

The conference fee for those registering before March 30 will be \$75. After that date, the fee is \$90. Members and employees of the sponsoring organizations may deduct \$25 from the conference fee.

Registration includes admission to all sessions, workshops, and exhibits, a copy of the ASSMR/Task Force Proceedings, receptions, Tuesday and Thursday luncheons, and daily coffee breaks.

The cost for the tours is \$150 for the six-day tour, and \$25 each for the one-day events.

For further information, contact Conference Chairman Jeff Skousen at 1106 Agricultural Science Building, West Virginia University, Morgantown, WV 26506 (304) 293-6256.

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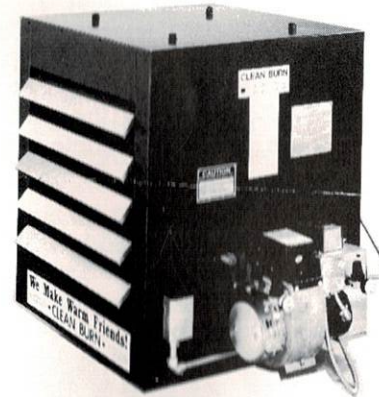
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# Cover Story

photo by Don Beightol

## West Virginia's AML Program

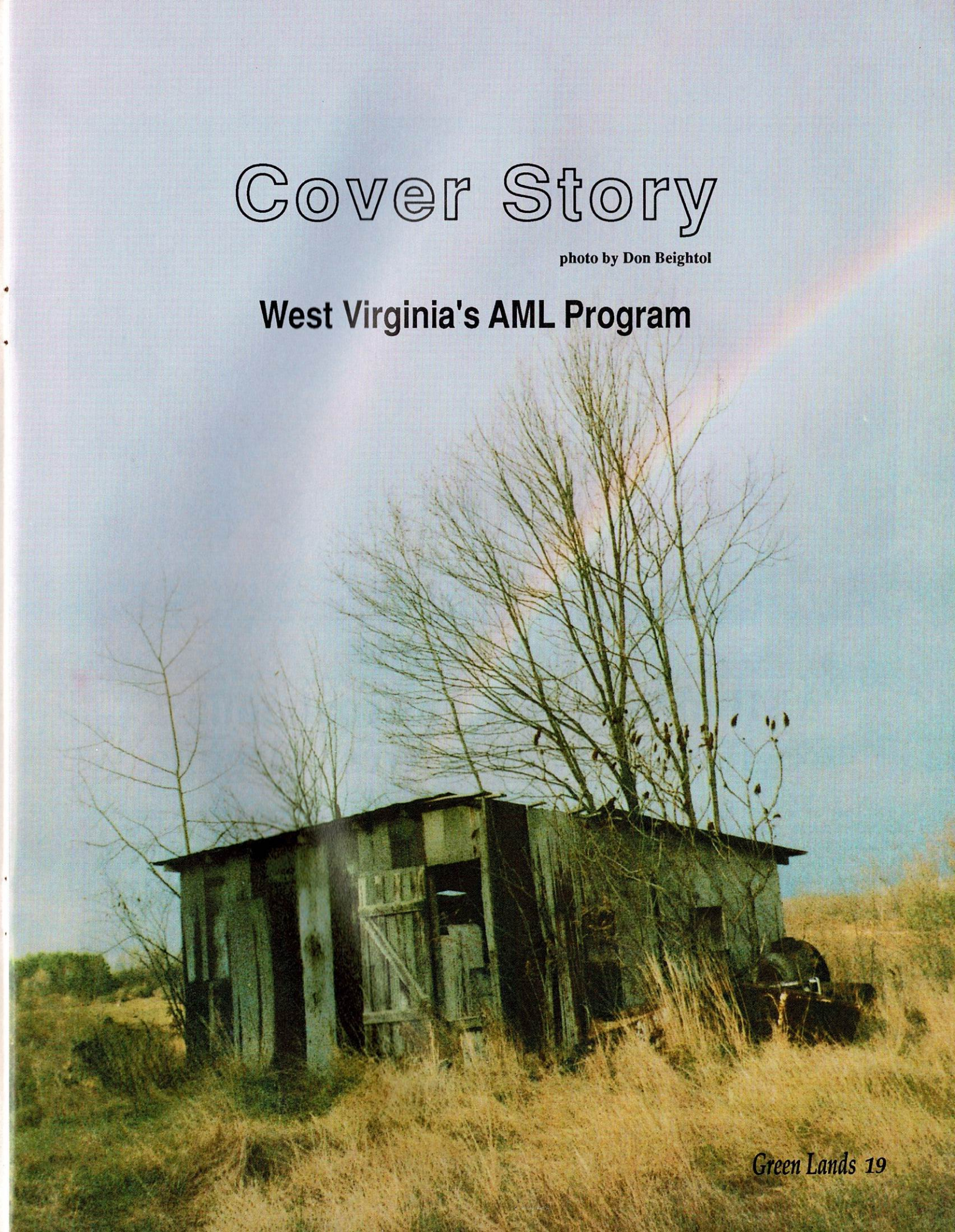






photo by Danny Pritt

The Webster Refuse Project in Preston County, completed by Green Mountain Co. In the right center of this aerial photograph is the hunting shelter shown on the cover. This structure was preserved at the request of the landowner.

## AML program keeps coal dollars flowing back to West Virginia

Congress is on the verge of breathing new life into the Abandoned Mine Lands program with the passage of a re-authorization package designed to extend the program through 2007. AML fees have been collected from coal companies, nationwide, since 1977, when the Surface Mining Control and Reclamation Act levied 35¢ per ton on surface mined coal, 15¢ per ton on underground production, and 10¢ per ton on lignite.

Under the original provisions of the Act, the program would expire in 1992, though accumulated funds could carry reclamation work for another five years or so. Collections are projected to total over \$3 billion by that date.

Congressmen and senators from western states have opposed the extension, on the basis that work in those states should be completed by the time current available funds are expended. The bill easily won approval from the House of Representatives in October with a concession to the western delegation, providing a 50% reduction in the

fees from any state which can demonstrate that all AML work has been completed.

Any such reduction would be granted only if the Secretary of Interior finds that no significant competitive advantage would result. Senate passage and subsequent presidential approval are expected.

HR 2095, as passed by the House, contains some changes in the allocation of funds. Current law authorizes states to deposit 10% of its annual state-sharing funds into a special trust fund to be used for additional work after the program expires. The new bill allows States to use that money to establish an acid mine drainage abatement and treatment fund.

Another change would specifically transfer 20% of the (Interior) Secretary's fund to the Soil Conservation Service for use in the Rural Abandoned Mine Program. Currently, RAMP may receive "up to 20%" of those funds, but is guaranteed nothing.

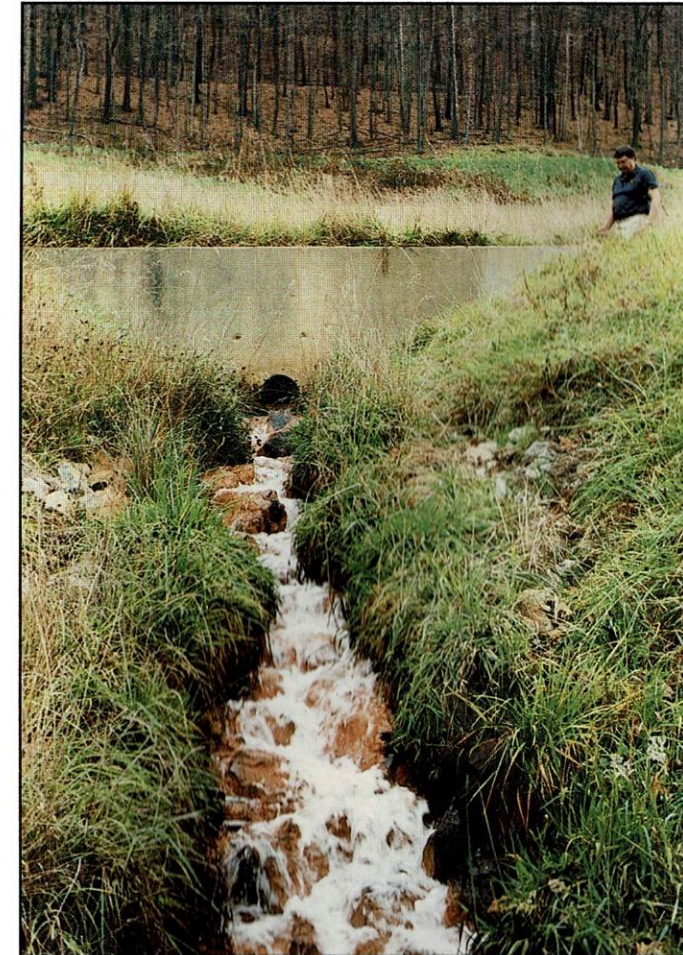


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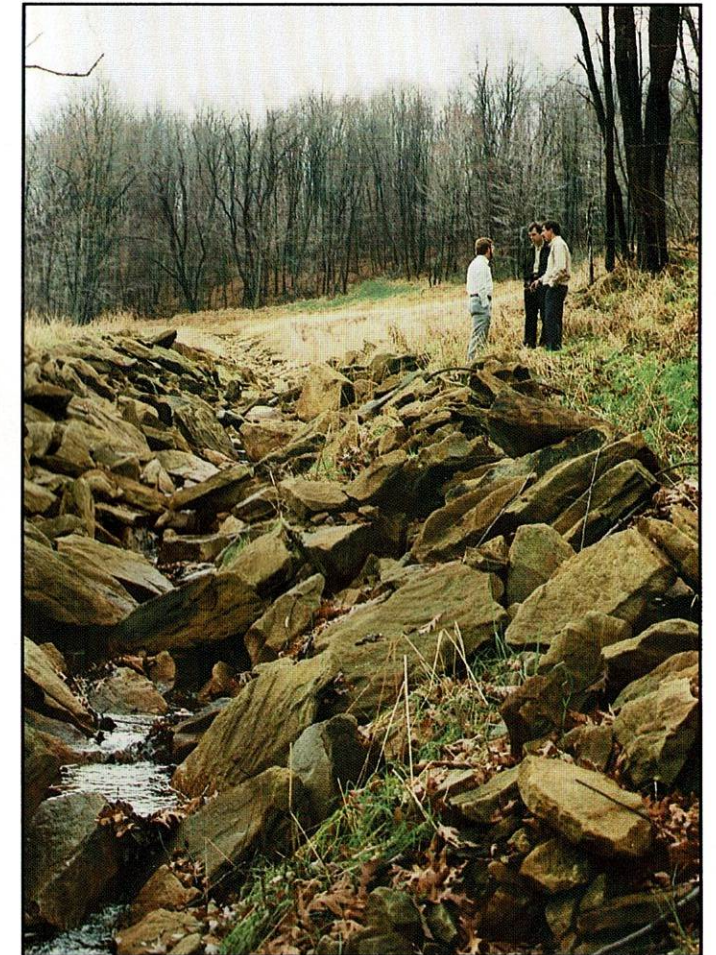


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**Pioneer Construction**  
Burke R & R - Preston County

The bill would also alter the eligibility of small operators under the Small Operators Assistance Program. Originally, a small operator was defined as those producing less than 100,000 tons per year. The re-authorization package raises the small operator limit to 300,000 tons per year.

To date, West Virginia coal companies have paid more than \$300 million into the fund. At current production levels, that's about \$25-30 million a year.

Under the cumbersome formula enacted in 1977, the West Virginia Department of Energy can get roughly 50% back for use on state projects.

So, if DoE can win grants from OSM in the neighborhood of \$15 million a year, then West Virginia is doing about as well as can be expected.

Results in recent years have been encouraging. In 1987, DoE's AML program contracted for 38 projects at \$21.9 million. In 1988, the figures jumped to 62 projects

and \$30.1 million. Last year, the program funded 30 projects at \$18.6 million. If the 1990 grant is approved as submitted, West Virginia will have another \$21.2 million to work with.

In an "old coal" state like West Virginia, the AML program is generating a lot of benefit. The identified inventory of Priority 1 & 2 sites is enough to justify continued projects for the foreseeable future.

Of the countless taxes on coal and coal production, AML is perhaps the most satisfying in terms of return on dollars invested.

Totally funded by the coal industry, AML is generating employment for mining and reclamation companies while simultaneously improving the environment.

The following pages are a tribute to the work of WV-DoE's AML staff, as well as to the companies which are doing the excellent work depicted here.





photo by Danny Pritt

**A. L. King, Ltd. - Canebrake - McDowell County**



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**A. L. King, Ltd. - Iroquois - Wyoming County**



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**Pioneer Construction - Berry Branch - Raleigh County**

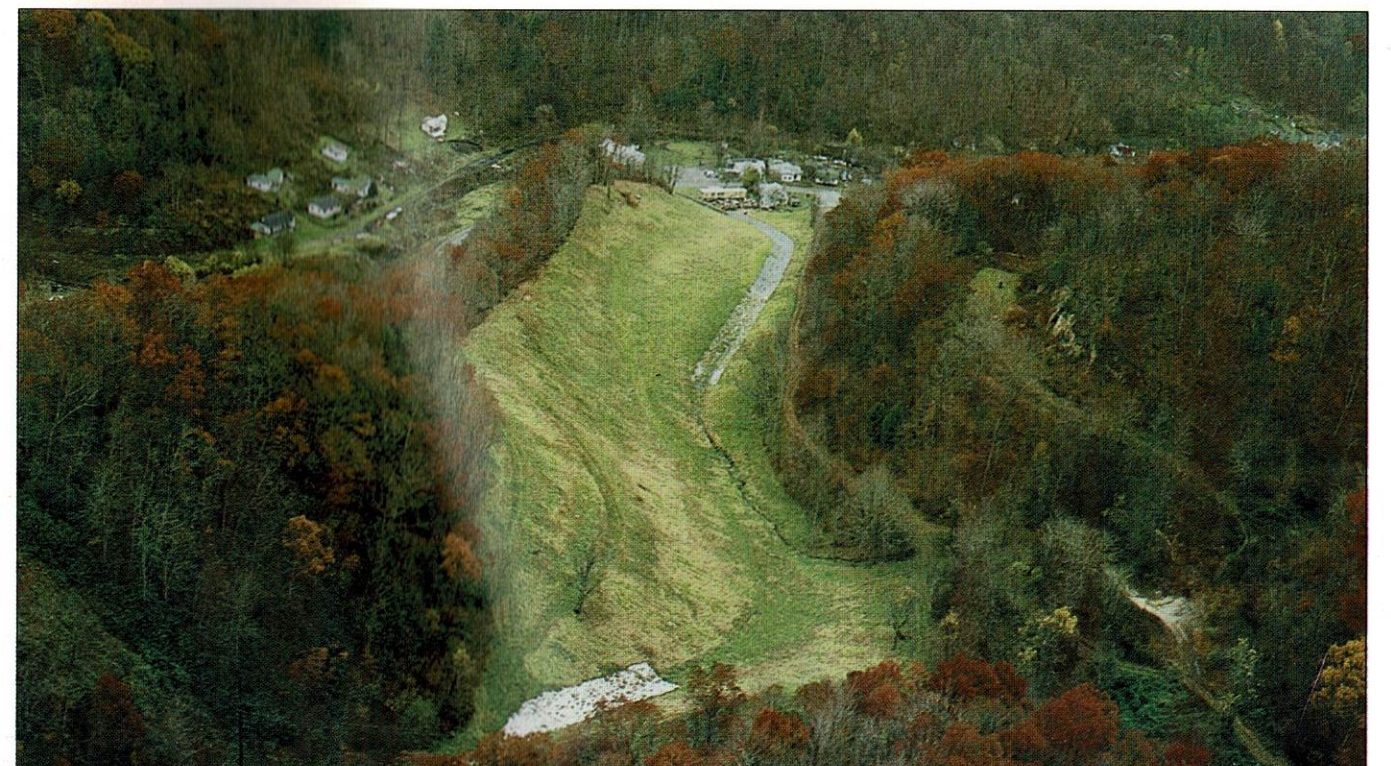


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**Garcie R. Marker & Sons - Rolfe Refuse - McDowell County**





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**North American Reclamation - Harding - Randolph County**



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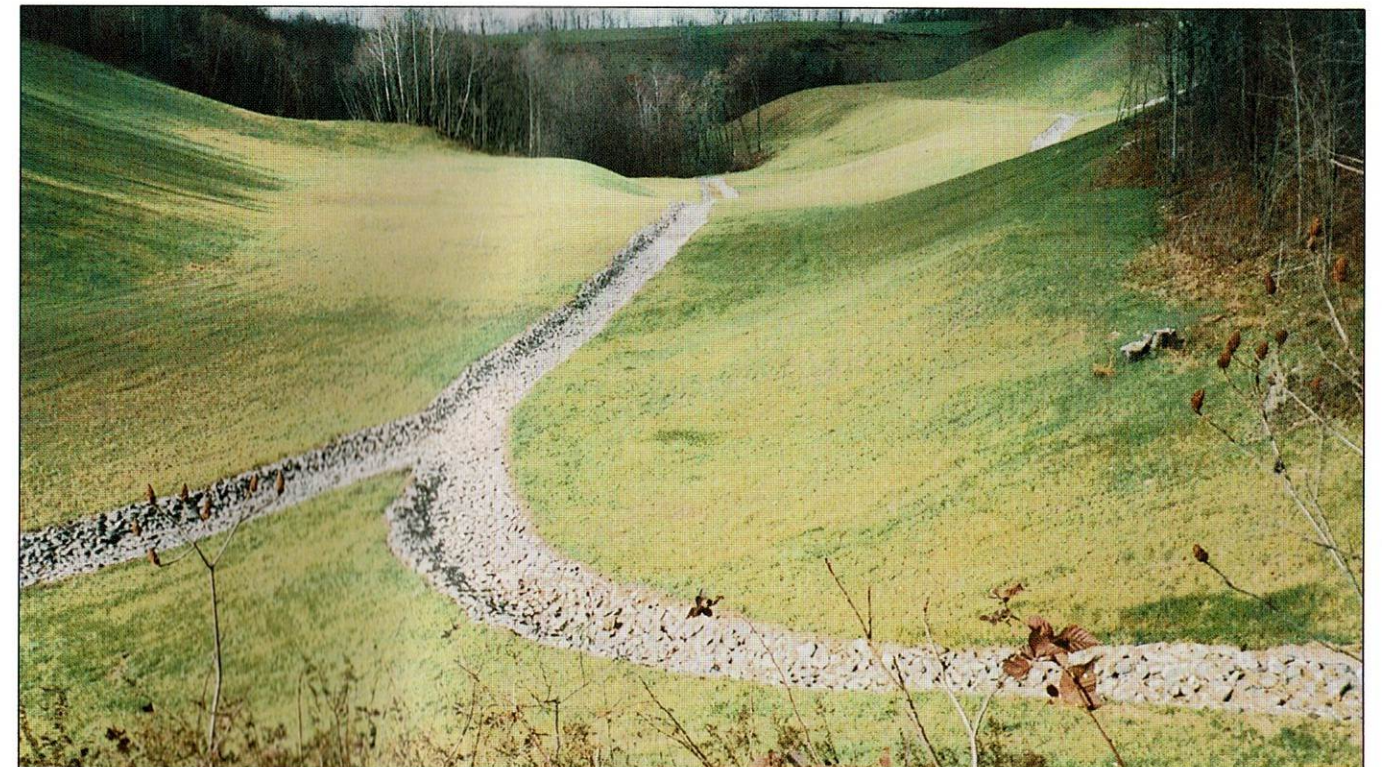


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**Breckenridge Corp. - Weltner (Ramp Project) - Monongalia County**



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**Battle Ridge Corp. - Hazy Creek - Raleigh**

photo by Danny Pritt

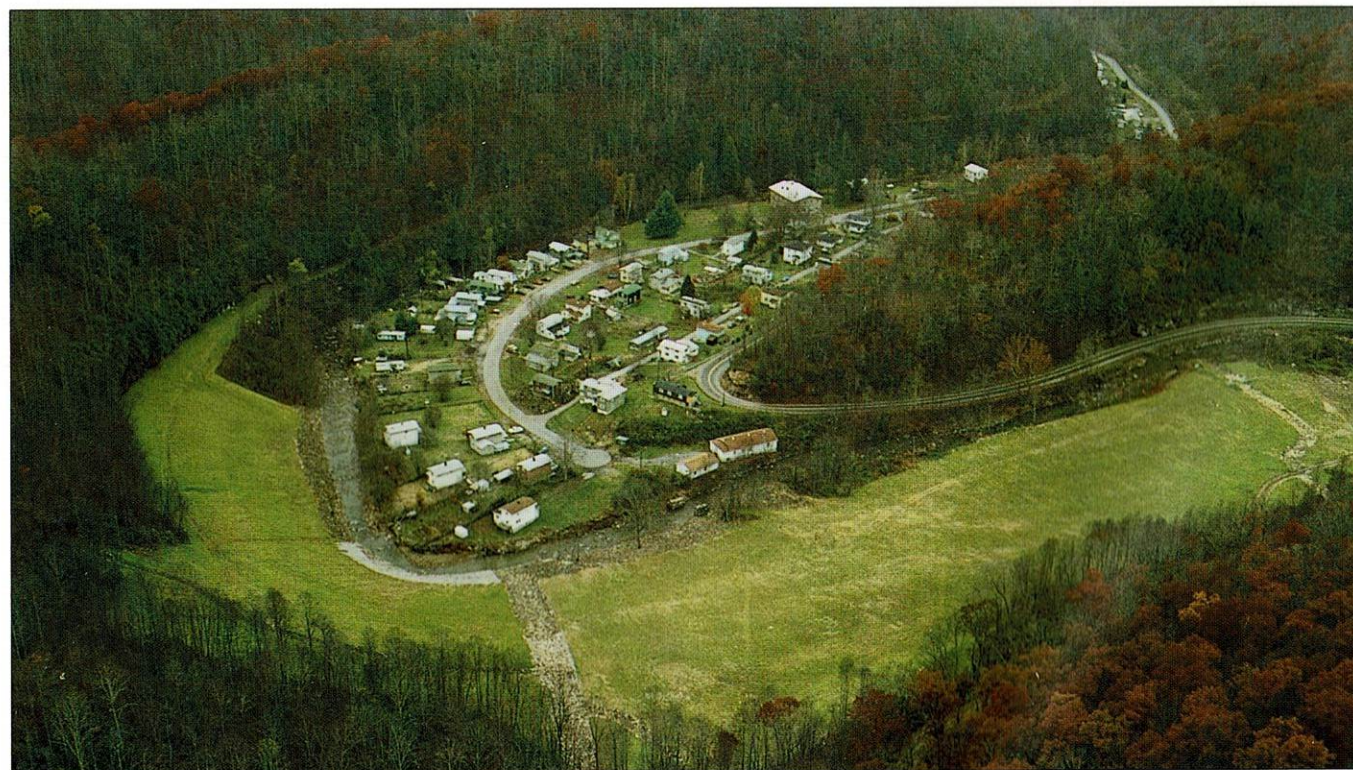


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# The Development of the Acid-Base Account

by Jeff Skousen, Richard M. Smith, &  
John Sencindiver - West Virginia University

## Original Ideas

Acid-Base Accounting originated from ideas based on estimates of the composition of the earth's crust. These estimates were presented and discussed in many classic mineralogy or geology texts beginning in the 1930's.

The earth's crust generally is composed of a higher percentage of cationic elements (namely calcium, magnesium, potassium, and sodium) in reactive forms than the percentage of anionic or acid-producing elements (e.g. sulfur, chlorine, fluorine, and phosphorus).

Other abundant mineral elements (including iron, aluminum, silicon, and oxygen) are weakly dissociated or relatively inactive and have only a minor influence on acidity or alkalinity.

Therefore, these ideas suggested that the dominance of one or the other type of elements in the rock would dictate the future potential of that rock to produce acidity or alkalinity.

Some of the earliest documented work on reclamation of surface mined areas in West Virginia was directed at revegetation efforts (Smith and Tyner 1945, Tyner et al. 1948). These reports acknowledged the effects of spoil quality on plant growth.

It was apparent to coal operators and regulators that reclamation potential of surface mined areas (mainly with reference to plant establishment and growth) was directly connected to the quality of the overburden material placed at the surface. Many early surface mine operations turned the overburden upside down relative to its original position as the overburden was removed to reach the coal. Such an operation deposited the original surface material into the pit, and the material near the coal seam was placed on the surface.

The replaced surface material may have been a black or, more commonly, gray color which indicated unweathered material. In many situations, pyritic sulfur was found in rocks associated with the coal seam and, upon weathering, produced acid conditions in the soil and may have caused an acid mine drainage problem.

## Spoil Classification Systems

Early reports in West Virginia identified three types of spoil material and distinguished these spoil types based on rock composition and degree of acidity. For example, type A spoil was very strongly acid spoil derived from geologic sections consisting of shales and sandstones with pyritic roof coals and black pyritic shales (Smith and Tyner 1945).

Such a system of spoil classification was of practical value for revegetation, and similar systems were subsequently developed for other coal mining areas including the mid-eastern coal region (Limstrom 1948), Pennsylvania (Davis 1965), and Eastern Kentucky (SCS 1973).

A spoil classification system proved useful for reclamationists to help determine lime and fertilizer rates, and to identify and seed plant species which are adapted to these specific minesoil conditions.

Knabe (1964) provided one of the earliest examples of characterizing alkaline versus acid minesoils. He refined the spoil type classification by placing a positive or negative number as a subscript. A positive subscript detailed the percent of  $\text{CaCO}_3$  in the spoil material while a negative number expressed the percent of potential unneutralized  $\text{SO}_4$  (the sulfides or pyrite was expressed as  $\text{SO}_4$ ). For example, A<sub>20</sub> was a spoil suitable for agriculture, with 20 percent unneutralized calcium carbonate in the material. A

T-10 spoil type was toxic with as much as 10 percent of potential unneutralized  $\text{SO}_4$ . Later, Knabe reported that he used a method called an "base-acid balance" which balanced the sum of all bases against all present acids, acid-producing minerals (sulfides), and exchange capacity of cations (Knabe 1973). His system then, accounted for the ultimate quantity of acidity or alkalinity that could be produced in the minespoil upon weathering.

Even though these minesoil classification systems were useful, a more important need was a method or technique that could distinguish, before mining, the materials in the undisturbed overburden that could be placed on the surface for revegetation and which materials should be buried beneath the rooting zone.

## Overburden Analysis Before Mining

Soon after Knabe reported on his work, researchers at West Virginia University began developing a system for balancing the acid and alkaline producing potential of overburdens prior to disturbance.

WVU researchers first studied overburdens in Preston County, WV and defined the acid-producing potential of rocks associated with the Freeport and Kittanning coal seams (West Virginia University 1971).

As the work continued in other parts of the state, they quantified acid-neutralizing material in overburdens and developed the term neutralization potential (NP) (Smith et al. 1974). Further research outside Appalachia confirmed the usefulness and application of the Acid-Base Account (Smith et al. 1976), and final field and laboratory procedures for the Acid-Base Account were published in 1978 (Sobek et al. 1978).

As early as 1971, Smith and his associates at West Virginia University recommended that sulfur profiles and acid-neutralizing capacities should be determined for all



Dr. Richard Smith and his associates conducted extensive field research in the development of the Acid-Base Account.

stratigraphic sections from the surface down to the coal seam before mining. In this way, net acidity or alkalinity for each geologic layer was calculated and water and minesoil quality could be predicted for particular minesoils.

## Laws and Regulations

The 1971 West Virginia surface mining and reclamation law required the operator to show in

the permit "the presence of any acid-producing materials which, when present in the overburden, may cause spoil with a pH below 3.5 and prevent effective revegetation." Regulations promulgated to implement the law in succeeding years used the Acid-Base Account to determine the presence or absence of acid-producing materials in the overburden.

Prior to federal surface mining and reclamation laws in 1977, "topsoiling" was seldom practiced. Therefore, the Acid-Base Account was particularly useful in selecting overburden layers which should be placed on the surface as "topsoil." It was also used to help select materials for special uses (e.g., hard sandstones for rock cores in valley fills, clayey materials for impermeable barriers, etc.).

The Acid-Base Account was the first technology available to assess the chemical quality of overburdens prior to disturbance. As a result, the concepts of pre-mine planning for reclamation and special handling procedures were formulated.

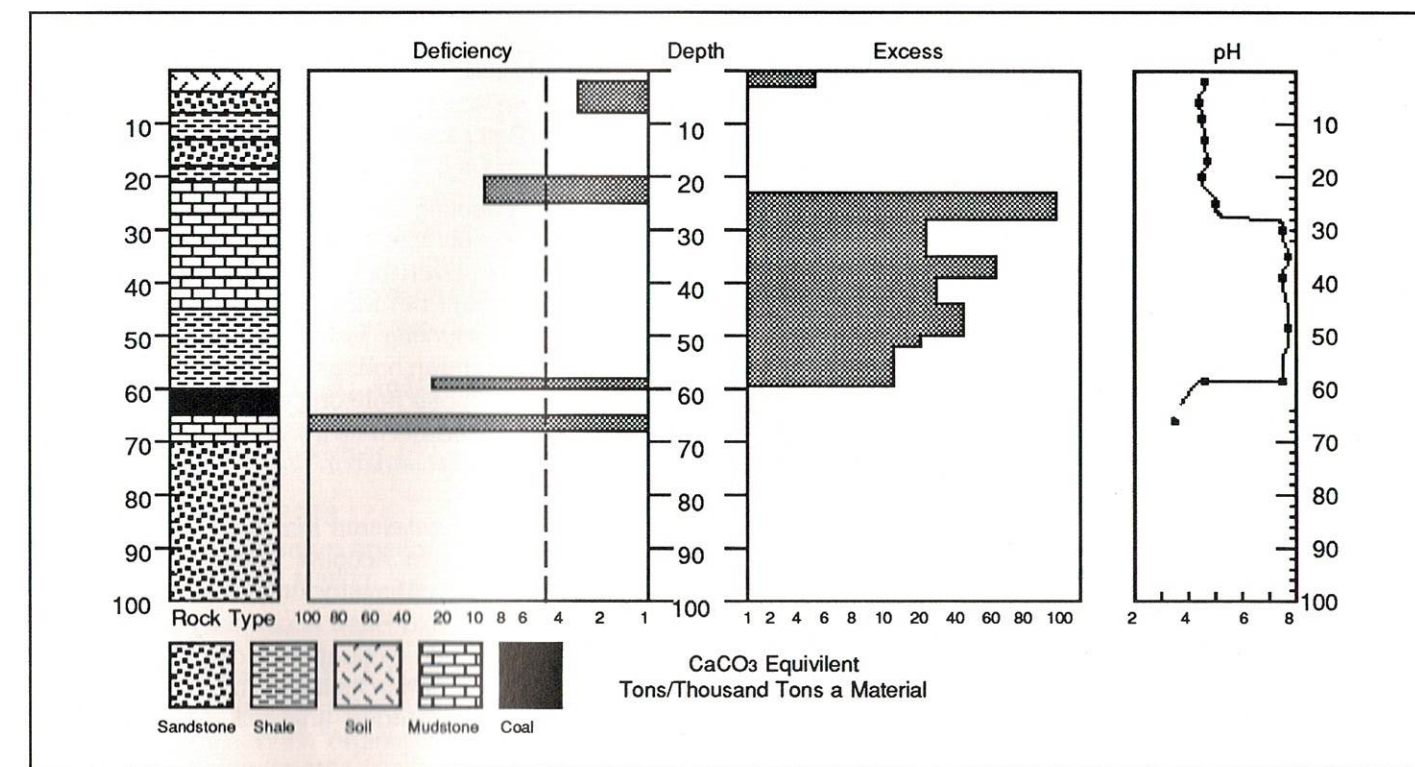
## Acid-Base Accounting and Water Quality

Overburden analysis came into widespread use with the passage of SMCRA in 1977. The law requires that an operator must identify in the permit any potentially acid-producing materials in the overburden and determine the probable hydrologic consequences of such materials after disturbance and reclamation. Since little research had been conducted on water quality prediction from disturbed areas, the coal industry and regulatory authorities applied



Sample Number	Bottom depth (feet)	Rock type	Fizz	Color	%S	CaCO <sub>3</sub> equivalent - tons/1000 tons of material				Paste pH
						Max. from %S	Amount present (NP)	Max. needed (pH7)	Excess	
1	3	Soil	0	7/3	.035	1.09	3.52		2.53	4.4
2	6	SS	0	8/6	.029	0.91	-1.51	2.42		4.3
3	6	SS	0	8/2	.023	0.72	-1.59	2.31		4.6
4	14	SH	0	7/4	.009	0.28	-0.60	0.88		4.6
5	17	SS	0	7/4	.009	0.28	-0.09	0.37		4.7
6	20	SH	0	8/3	.011	0.34	-0.17	0.51		4.5
7	24	MS	0	7/1	.263	8.22	-0.94	9.16		4.8
8	28	MS	1	7/1	.179	5.59	78.33		72.74	7.8
9	35	MS	0	7/1	.028	0.88	15.77		14.89	7.9
10	39	MS	1	7/0	.140	4.38	39.71		35.33	7.8
11	55	MS	1	7/1	.278	8.69	25.25		16.56	8.0
12	49	SH	1	7/1	.079	2.47	25.76		23.29	8.1
13	51	MS	1	7/1	.665	20.78	32.45		11.67	7.9
14	44	SH	1	7/1	.610	19.06	25.88		6.82	7.8
15	58	SH	0	6/1	.355	11.09	17.78		6.69	7.3
16	59	SH	0	4/1	.800	25.00	3.80	21.20		4.2
17	64	Coal	*	*	*	*	*	*	*	*
18	67	MS	0	6/1	2.820	88.12	-2.78	90.90		3.5

**Table 1.** The Acid-Base Account, in this example, describes each major layer in the overburden by horizon thickness, rock type, fizz, color (value/chroma), percent sulfur, neutralization potential, and pH.



**Figure 1.** Graphic representation of overburden properties as measured by the Acid-Base Account. The figure illustrates some of the data in Table 1.

current overburden analytical methods and adapted the available methods to these purposes.

The Acid-Base Account, already widely used by this time as an overburden selection tool, was applied to predict post-mining drainage quality. Since then, there have been many discussions and much controversy concerning the ability of the Acid-Base Account to predict post-mining water quality (adapted from Erickson and Hedin 1988).

### Acid-Base Account Principles

The Acid-Base Account was first described in detail in 1973 (Grube et al. 1973). Logging of overburden cores and/or observations of a fresh highwall are used to distinguish geologic layers. Each of the layers are identified by: 1) rock color; 2) rock hardness; 3) rock streak on ceramic plate; 4) rock grittiness; 5) rock layering; and 6) rock fizz. Toxic, potentially toxic, and alkaline-producing overburden layers are defined by three measurements: 1) pH; 2) total or pyritic sulfur; and 3) neutralization potential (Table 1).

While many other factors and complex interactions have an influence on the chemical production potential of rocks (including microorganisms, trace elements, depositional environments, forms of pyrite, rare catalytic agents,

uncommon compounds, and lithologic peculiarities), it was felt that dominant rock properties would likely produce the most predictable response upon weathering.

Diagnosis of the prominent rock properties would also provide opportunities for solutions of the major problems related to coal overburden quality and resulting drainage.

The formation of acid from the oxidation of pyrites and other reduced sulfur compounds is well known. The equation shows that a material containing 0.1 % sulfur, all as pyrite, would yield upon complete reaction an amount of sulfuric acid that requires 6,250 pounds of calcium carbonate to neutralize one thousand tons of the material. When sulfur in the overburden rock is exclusively pyrite, the total sulfur content of the rock accurately quantifies the acid-producing potential (if it were all to react). When organic and/or sulfate sulfur are present in significant amounts, total sulfur measurements overestimate the amount of acid that will be formed upon oxidation.

The natural base (alkali and alkaline-earth cations, commonly present as carbonates or exchangeable cations on clays) content of overburden materials is important in evaluating the future chemical producing potential of the overburden.

In overburden containing alkaline and pyritic material, the soluble bases may be sufficient to neutralize the acid at a rate equal to or exceeding the rate of acid production. Higher alkalinities also help control bacteria concentrations and restrict ferric iron activity which are both known to accelerate acid generation.

Quantification of neutralizing bases and carbonates is accomplished by reaction with hydrochloric acid. A balance of the acid-producing potential and neutralizing bases present in the sample indicates the ultimate acidity or alkalinity that might be expected in the material.

An Acid-Base Account illustrates the ultimate acidity or basicity of different rock zones in the overburden (Figure 1). From the beginning, the aim of Acid-Base Accounting was to determine how much neutralizing material was needed in order to neutralize all of the strong acids that could potentially form in coal overburden materials, especially where pyritic materials were known to occur. Therefore, the value of 6,250 pounds of calcium carbonate per 0.1% sulfur is calculated by dividing the molecular weight of CaCO<sub>3</sub> (100) by the molecular weight of sulfur (32).

That is, material containing 0.1% pyritic sulfur requires 3.125 tons (6,250 pounds) of CaCO<sub>3</sub> to neutralize the acid

that could be formed from 1000 tons of the material. At 1% sulfur, 31.25 tons of calcium carbonate equivalent would be required to neutralize the acidity, and provide a margin of neutralization safety against sulfur percentages that may not all be pyritic and for pyritic sulfur that may not all react.

Three basic assumptions should be understood when using Acid-Base Accounting (adapted from Perry 1985). First, the values for potential acidity and neutralization potential represent maximum or ultimate quantities from whole rock analysis. Complete reaction of all pyrite and bases probably does not occur in a mine backfill, thereby affecting the total amount of acidity or alkalinity which is produced. Second, sulfur exists in three chemical forms in coal bearing rocks: sulfide, sulfate, and organic. Pyritic sulfur (sulfide) is the prominent acid producer. Total sulfur analysis generally overestimates pyritic sulfur content because all three forms are usually present. And third, Acid-Base Accounting recognizes only the ultimate amount of acidity or alkalinity that the rock will produce. Pyrite may oxidize faster or slower than alkaline materials. Reaction rates of pyrite and carbonates are not determined by this method.

Experience with Acid-Base Accounting has shown that



overburden layers which provide values greater than 5 tons per 1000 tons in the Max Needed column (the column which represents surplus acidity in the layer) produce acid, while values greater than 20 tons per 1000 tons in the Excess column (the column which represents excess alkalinity in the layer) usually produce alkaline drainage (Skousen et al. 1987). Layers between 0 and 5 in the Max Needed column or less than 20 tons in the Excess column may produce alkaline or acid discharges or they may be neutral (producing neither alkalinity or acidity). Where little or no pyrite exists, even with low amounts of neutralizing potential, little acid will be produced. Such low numbers in either column should raise suspicions during interpretation and cause a closer look at other measurements.

It is not wise to rely simply on one number in either the Max Needed or Excess columns to make a judgment. When questions arise, these rock layers, in many cases, require some other method or analysis to ascertain the rock's chemical production potential.

A common error when using the Acid-Base Account as a predictive method of AMD production occurs when the Max Needed and Excess columns are summed together for the entire overburden above the coal seam (the Max Needed column representing a negative number and the Excess column representing a positive number). Several studies have made AMD predictions based on the Acid-Base Account with overburden volume adjustments. Summing of the columns assumes thorough mixing of all overburden materials in a backfill, uniform rates of weath-

ering of all materials, and water contact throughout the backfill. These assumptions are not valid.

### Summary

Acid-Base Accounting balances maximum or ultimate potential acidity against total neutralizers in each overburden horizon sample. Even though the method has several assumptions that must be understood during interpretation, Acid-Base Accounting satisfies the requirement to identify which overburden horizons will or will not produce acid, and pinpoints those horizons which should be analyzed further. With accurate data and proper interpretation, practical mining and reclamation plans can be designed and implemented.

Despite the many criticisms that have been leveled against it, the Acid-Base Account is the preferred first measure of overburden chemistry for both the industry and regulatory agencies. Acid-Base Accounting is the fastest and easiest way to begin evaluation of overburden material. It should be used within its limits, in conjunction with other methods of overburden analysis, and with good common sense.

### Acknowledgements

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# Coal Calendar

## February

- 27-28 **Interstate Mining Compact Commission Winter Business Meeting**, Omni Georgetown Hotel, Washington, D.C., contact IMCC, 459B Carlisle Dr., Herndon, VA 22070, (703) 689-2461.

## March

- 12-14 **Short Course, "Mine Instructor Training,"** University Park, PA, contact R. L. Franz, Penn State University, 126 Mineral Sciences Bldg., University Park, PA 16802, (814) 865-7472.
- 20-21 **Mergers & Acquisitions Special Institute**, Hyatt Regency Columbus, Columbus, OH, contact Paul L. Dunkle, III, East Mineral Law Foundation, WVU Law Center, P.O. Box 6130, Morgantown 26506, (304) 293-2470.
- 26-28 **Short Course, "Fundamentals of Surface Mining,"** University Park, PA, contact R. L. Franz, Penn State University, 126 Mineral Sciences Bldg., University Park, PA 16802, (814) 865-7472.

## April

- 5-6 **Eastern Mineral Law Foundation, Mine Safety Special Institute**, Mayflower Hotel, Washington, D.C., contact Paul L. Dunkle, III, East Mineral Law Foundation, WVU Law Center, P.O. Box 6130, Morgantown 26506, (304) 293-2470.
- 9-11 **Short Course, "Mine Cost Analysis and Control,"** University Park, PA, contact R. L. Franz, Penn State University, 126 Mineral Sciences Bldg., University Park, PA 16802, (814) 865-7472.
- 18-20 **Short Course, "Computer Modeling of Subsidence with SPASID,"** University Park, PA, contact R. L. Franz, Penn State University, 126 Mineral Sciences Bldg., University Park, PA 16802, (814) 865-7472.
- 23-26 **Short Course, "Elements of Mine Electrical Systems,"** University Park, PA, contact R. L. Franz, Penn State University, 126 Mineral Sciences Bldg., University Park, PA 16802, (814) 865-7472.
- 24-26 **The 1990 Mining and Reclamation Conference and Exhibition**, Charleston Civic Center, Charleston, contact Jeff Skousen, Conference Chairman, 1106 Agricultural Science Building, West Virginia University, Morgantown 26506, (304) 293-6256.

NOTE - This conference combines the following meetings:

**7th Annual Conference, American Society for Surface Mining & Reclamation; 10th Annual Surface Mine Drainage Task Force Symposium; Appalachian Surface Mining and Reclamation Exhibition.**

- 26-27 **Conference, "Comparative Economics of Clean Coal Technologies,"** Vista International Hotel, Washington, D.C., contact Pasha Publications, 1401 Wilson Blvd., Suite 900, Arlington, VA 22209, (703) 528-1244.
- 26-28 **Annual Meeting, National Independent Coal Operators' Association**, Holiday Inn North, Lexington, KY, contact NICOA, 1514 Front St., Richlands, VA 24641, (703) 963-9011.
- 30-2 **Short Course, "Groundwater Flow and Transport Modeling,"** University Park, PA, contact R. L. Franz, Penn State University, 126 Mineral Sciences Bldg., University Park, PA 16802, (814) 865-7472.

## May

- 7-10 **American Mining Congress Coal Convention**, Cincinnati Convention Center, Cincinnati, OH, contact AMC, 1920 N St. NW, Washington, D.C. 20036, (202) 861-2800.
- 23-25 **11th Annual Institute, Eastern Mineral Law Foundation**, Omni Netherland Hotel, Cincinnati, OH, contact Paul L. Dunkle, III, East Mineral Law Foundation, WVU Law Center, P.O. Box 6130, Morgantown 26506, (304) 293-2470.
- 23-26 **American Mining Congress, Mining Convention '90**, The Fairmont Hotel, New Orleans, LA, contact AMC, 1920 N St. NW, Washington, D.C. 20036, (202) 861-2800.



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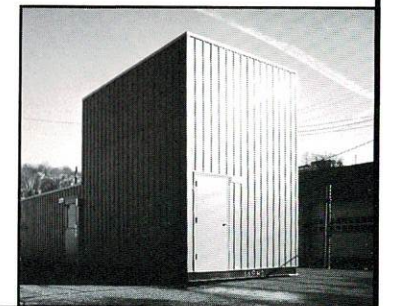
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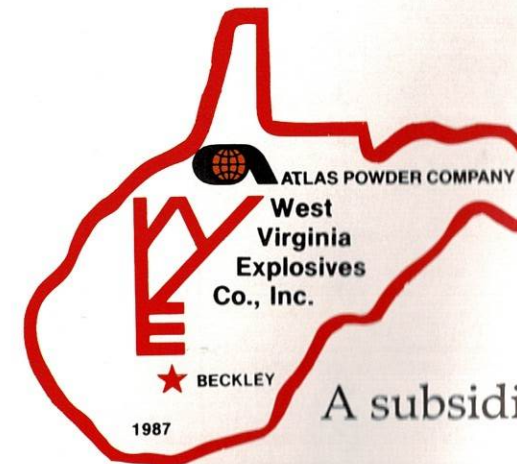
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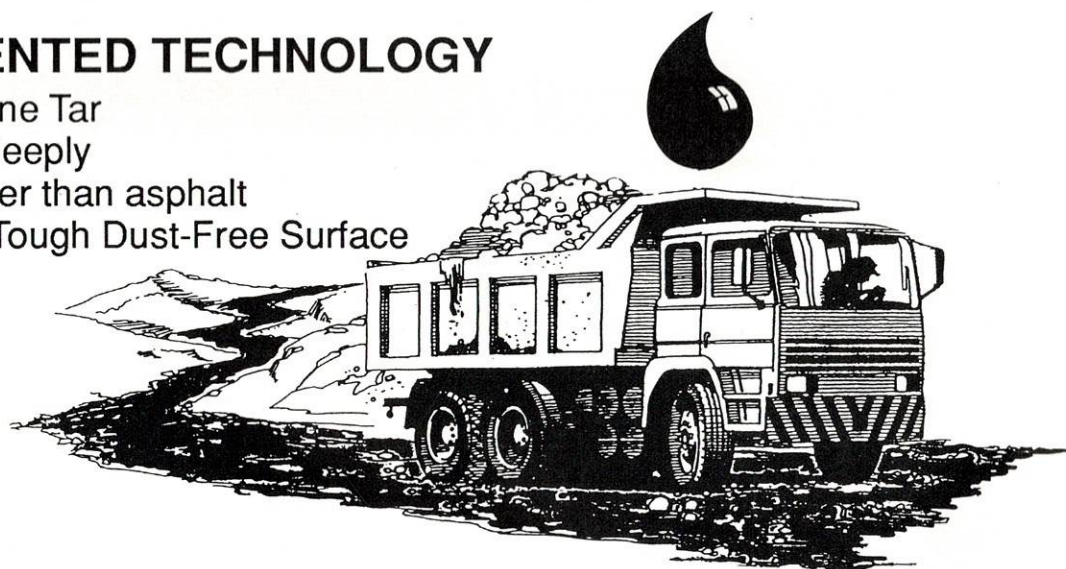
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