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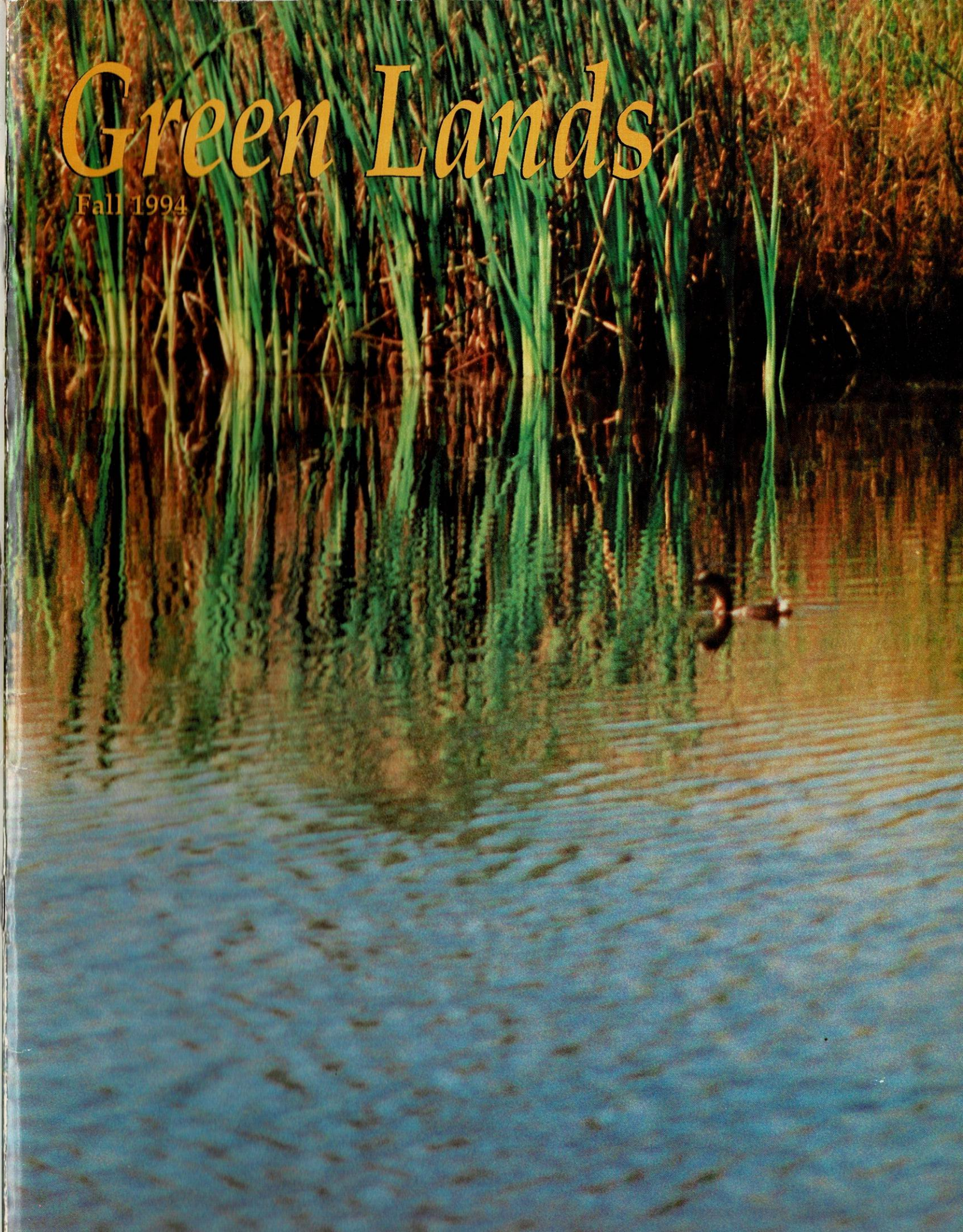
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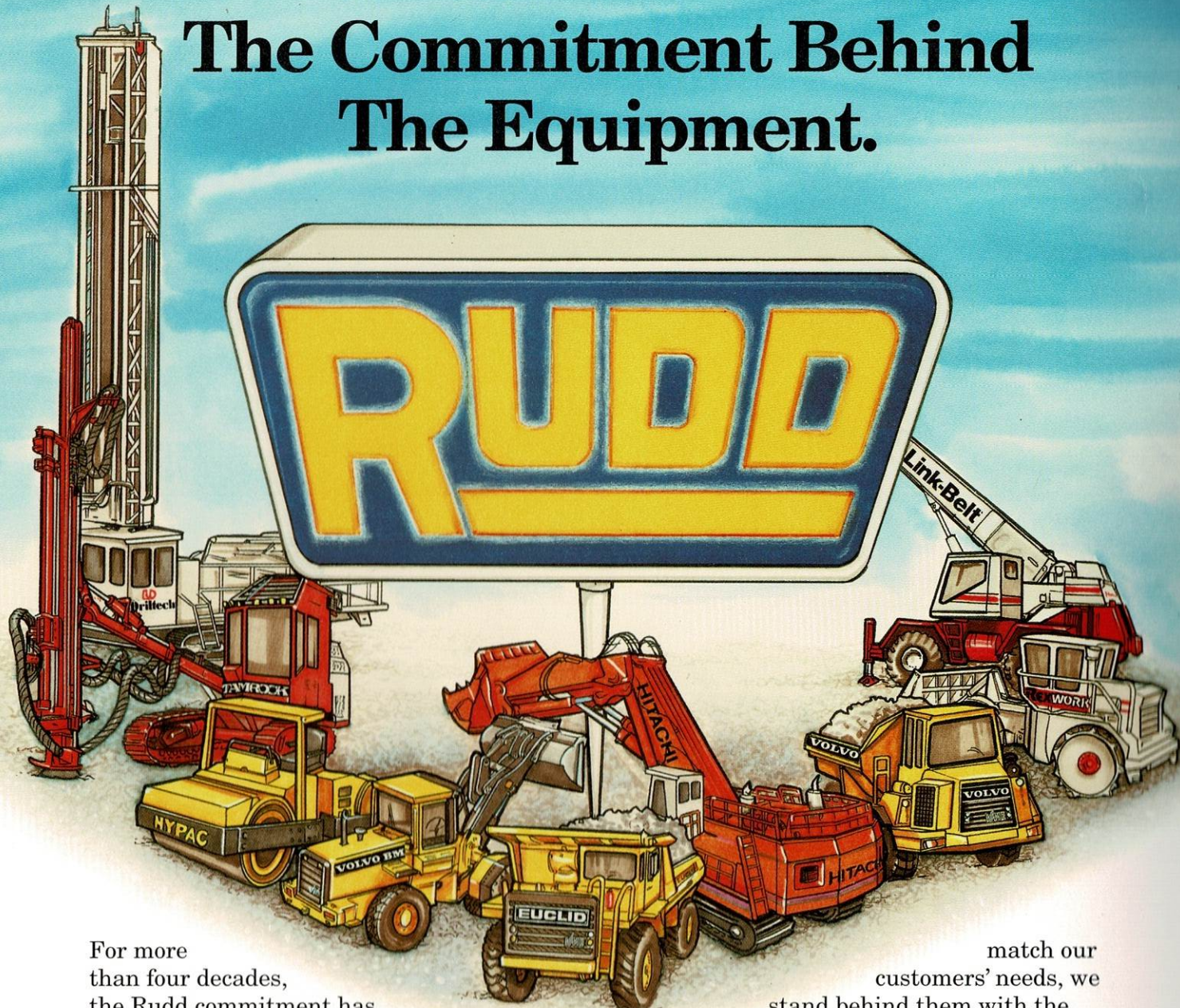
# Green Lands

Fall 1994





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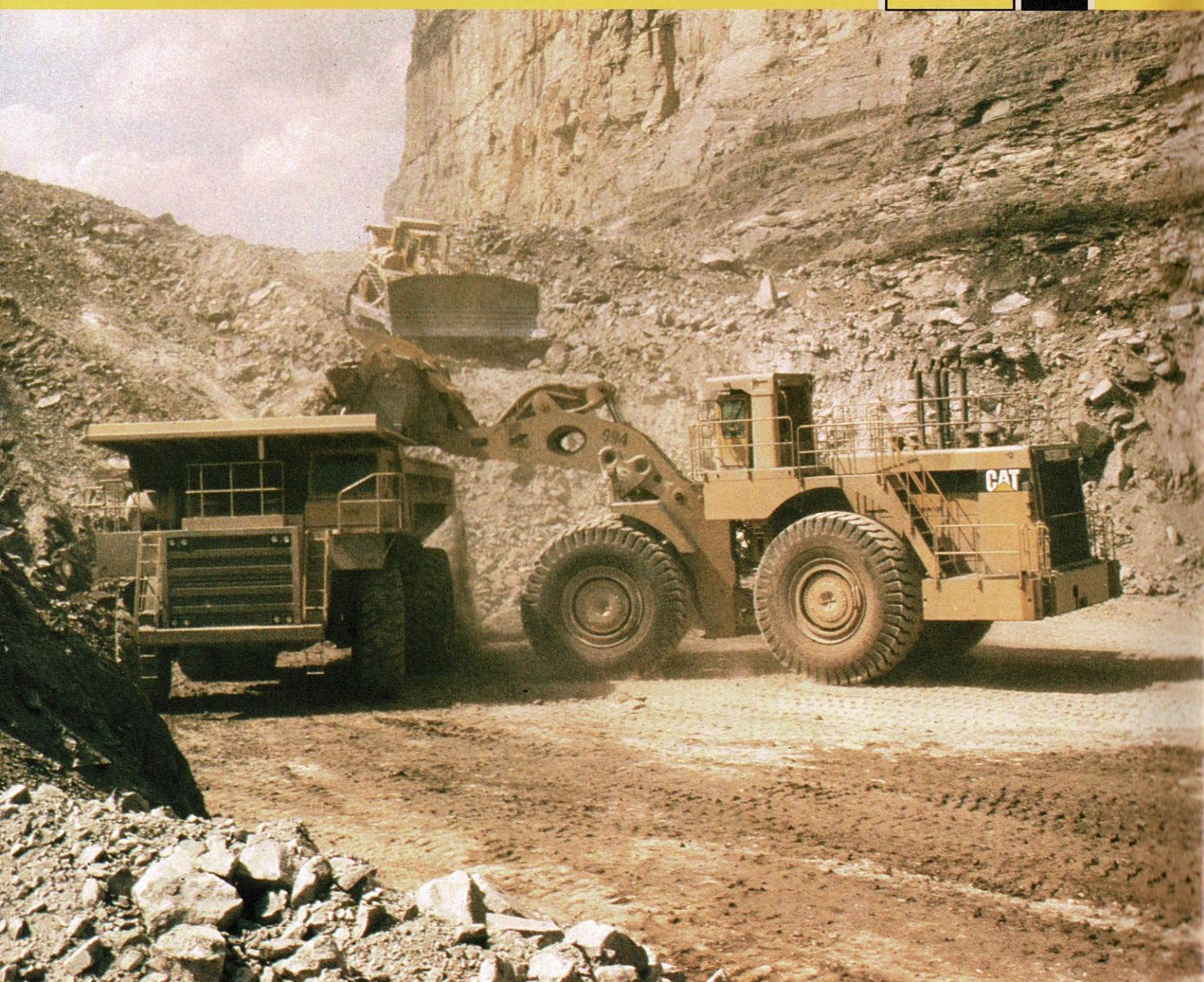
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# Green Lands

## Volume 24 Number 4

- 8 WVMRA Chairman is Sid Young
- 12 Repeat winners of 'Company Pride' Awards
- 29 Mine profile -- Wylo
- 36 Open limestone channels for treating acid mine drainage: A new look at an old idea
- 44 Coal Calendar
- 45 Association Notebook

### Green Lands

is a quarterly publication of the West Virginia Mining & Reclamation Association, with offices at 1624 Kanawha Boulevard East Charleston, West Virginia 25311 (304) 346-5318, FAX 343-5310.



### Our Cover

When Arch Mineral was formed in 1987, the Wylo mine was already well along. Now, AOWV is thriving, with state-of-the-art facilities, and Wylo has matured into an award winning mine. See page 29.

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## Index to Advertisers

Akers Supply.....	33	Miller & Miller.....	35
Anderson of West Virginia .....	17	Morton Specialty Insurance Partners.....	44
Beckwith Machinery.....	inside back cover	Mt. State Bit Service.....	4
Bell Farms Reclamation Service.....	28	National Ammonia.....	19
Bridgeport Trucking.....	43	Nell Jean Enterprises.....	42
Carter Machinery.....	2	New Directions Media.....	42
Chapman Printing.....	26	Ohio Seed.....	28
Cecil I. Walker Machinery.....	21	Penn Line Service.....	34
Crown Hill Equipment .....	6	Pentree.....	19
Cummins Cumberland.....	5	Petroleum Products .....	19
Eagle Carbon.....	32	REICHdrill.....	1
Flat Top Insurance.....	16	Rish Equipment.....	back cover
Heavy Machines.....	27	Rudd Equipment.....	inside front cover
Hotsy Equipment.....	33	Stowers & Sons.....	18
ICI Explosives .....	20	Terra Engineers.....	42
J & G Seeding .....	33	TerraSod.....	32
McGrew Tire .....	43	The Greenbrier .....	7
Massie Reclamation.....	18	Triangle Surety Agency .....	33

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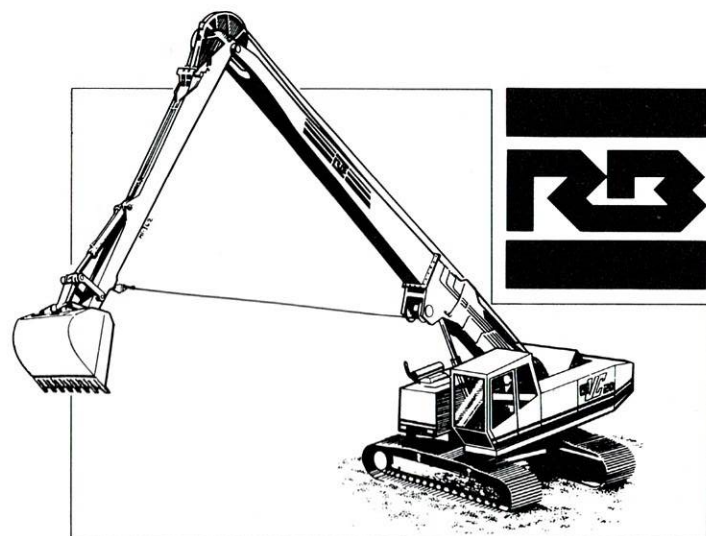
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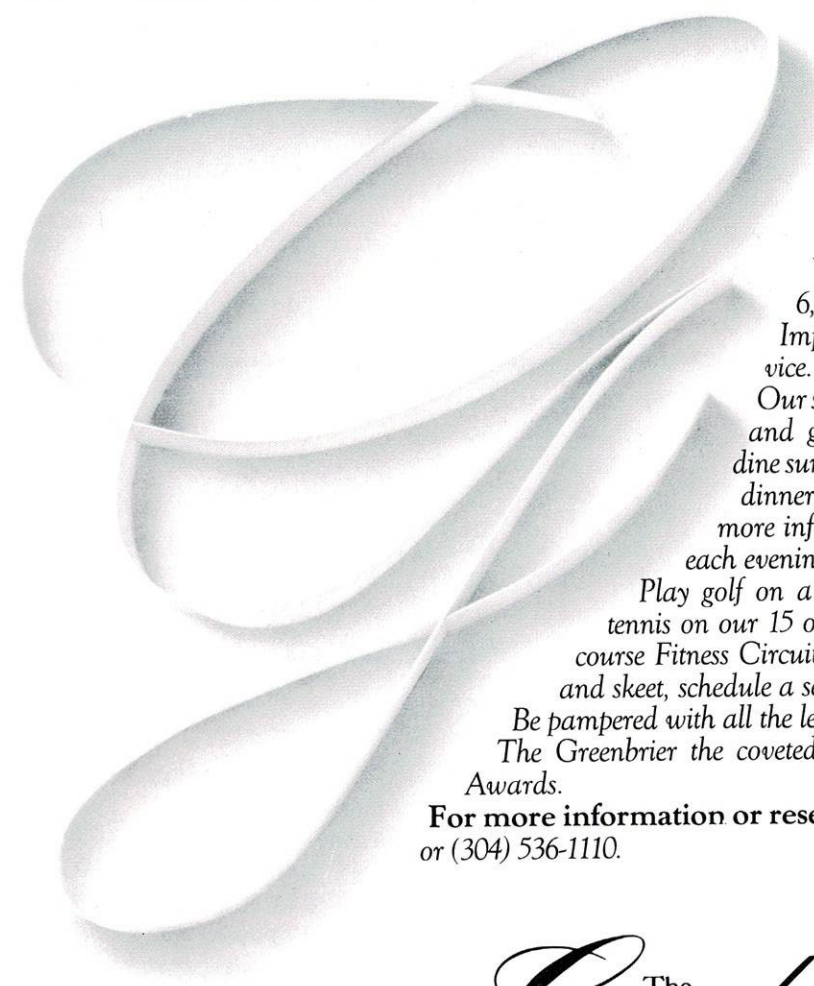
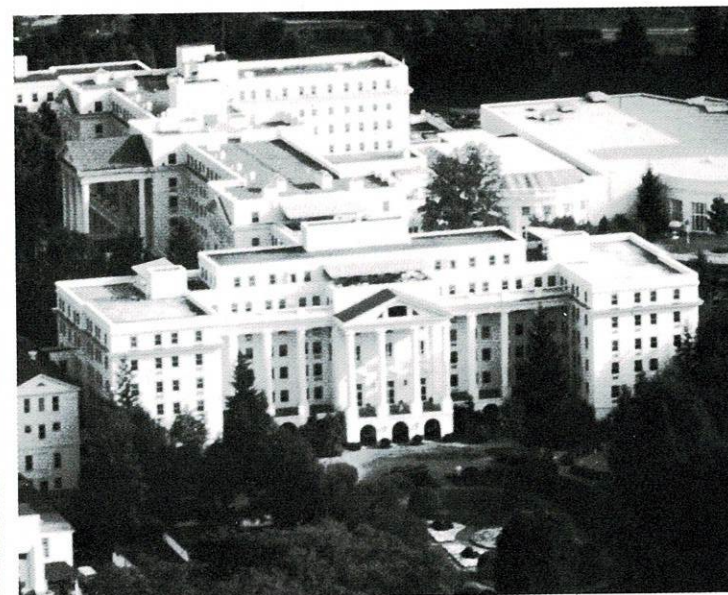
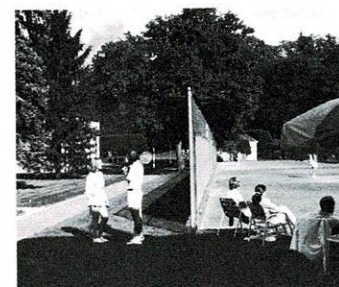


## Crown Hill Equipment, Inc.

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### The Greenbrier Welcomes The West Virginia Mining and Reclamation Association

We are looking forward to our many friends returning once again to The Greenbrier this year and assure you of a warm welcome.

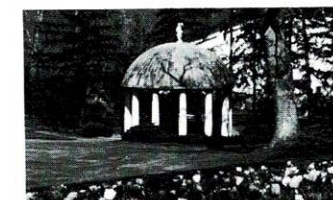
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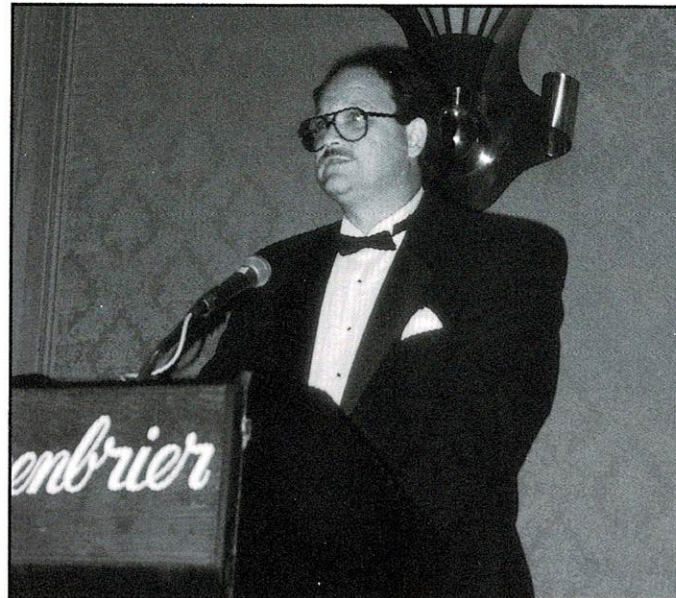
## The legend continues



# New WVMRA Chairman is Sid Young

Sidney R. Young, III, President of Hampden Coal Co., Inc., Gilbert, is the new chairman of the Board of Directors of the West Virginia Mining & Reclamation Association. He was elected at the Association's Annual Meeting to succeed 1993-94 Chairman John R. Bryan of The Pittston Coal Group, Lebanon, VA.

Sid is a native of Matewan and a third generation coal worker. After earning a mining engineering degree from West Virginia University, he began his coal career as a section foreman with Rawl Sales & Processing, working his way up to Assistant Vice President for Planning & Development before accepting a position as Vice President of Operations with Cumberland Village Mining Group. He became President and Chief Operating Officer for that company before taking the reins of Hampden Coal in August, 1987. Sid is also President of Guyandotte Consulting. Both companies are wholly owned subsidiaries of International Industries, Inc.



Sid Young takes the podium at the outset of his term as Chairman of the West Virginia Mining & Reclamation Association.

Through Hampden Coal, Sid has been affiliated with WVMRA for several years and has served on the Board of Directors for the past five years, including a term as Secretary. Sid and his wife Susan live just across the Kentucky border from Williamson, WV, where he is involved with the Williamson Twelfth Man Club, the School Improvement Council for Williamson Junior High School, the West Virginia Coal Mining Institute, the Tug Valley Coal Institute, and the First Methodist Church.

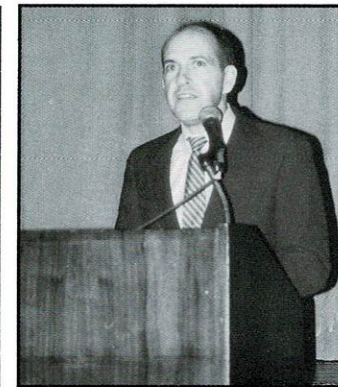
## WVMRA Past Chairmen

1966-67	Leo Vecellio, Sr.	1981-82	William C. M. Butler, III
1967-68	F. B. Nutter, Sr.	1982-83	Donald R. Donell
1968-69	Arch F. Sandy, Jr.	1983-84	Tracy W. Hylton
1969-70	John C. Anderson	1984-85	Carl DelSignore
1970-72	G. B. Frederick	1985-86	Dwight M. Keating
1972-73	James L. Wilkinson	1986-87	Theodore J. Brisky
1973-74	Lawson W. Hamilton, Jr.	1987-88	James W. Anderson
1974-75	James C. Justice, Sr.	1988-89	Roy G. Lockard
1975-76	H. L. Kennedy	1989-90	Paul F. Hutchins
1976-77	Frank D. Jennings	1990-91	Kenneth G. Woodring
1977-78	James H. Harless	1991-92	R. Donald Cussins
1978-79	John J. Faltis	1992-93	Gerald W. Ramsburg
1979-80	Charles T. Jones	1993-94	John R. Bryan
1980-81	Lawrence A. Streets		

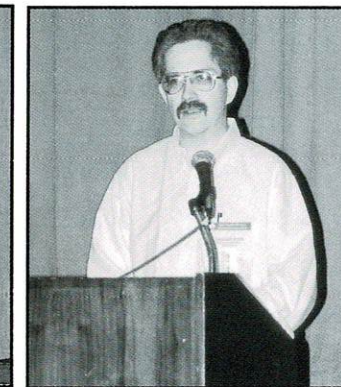
## Speakers



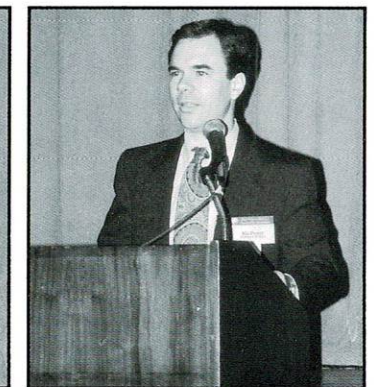
Eddie Wiles  
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Development  
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Dean Hunt  
Jackson & Kelly  
"Current Status of Water  
Quality Issues"



Leonard Knee  
Bowles Rice McDavid Graff & Love  
"Criminal Prosecution to  
Enforce Environmental Law"



Christopher Power  
Robinson & McElwee  
"West Virginia's  
Environmental Handbook"

## Other new officers

K. Donald Nicewonder of Premium Energy, Inc., Bristol, VA, was elected to the post of 1st Vice Chairman and Markus J. Ladd of Mingo Logan Coal Co., Wharnclyffe, was chosen as 2nd Vice Chairman for the coming year. James C. Justice, II of Bluestone Coal Co. in Beckley, was elected Secretary and Wayne H. Stanley of Stanley Industries, Bridgeport, is the new Treasurer. J. Christopher Supcoe of Crown Hill Equipment Co. in Hansford, will serve as Chairman of the Associate Division.

## Board members

Two members were newly elected to the Board, including Edward F. Surgeon of Cummins Cumberland, Inc., Louisville, KY and Donald L. Blankenship of A.T. Massey Coal Company, Inc., Richmond, VA. Eight others were re-elected to the Board, including Jim Justice, Markus Ladd, Wayne Stanley, John Bryan, Paul F. Hutchins of High Power Energy, Columbus, OH, John C. Smith of Rudd Equipment Co., Charleston, John C. Williamson of Cecil I. Walker Machinery Co., Charleston, and Kenneth G. Woodring of Ashland Coal, Inc., Huntington.

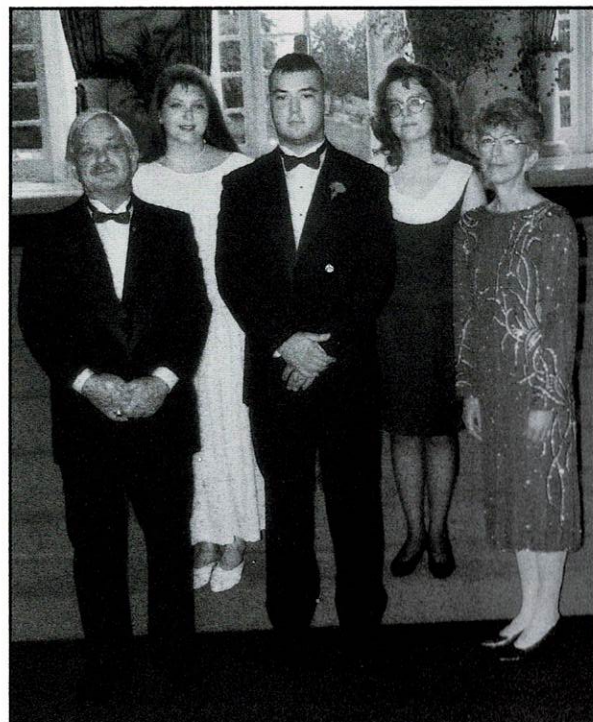
## New WVMRA members

Fifteen companies were approved for membership during the Annual Meeting early this month, including five in the General Division and ten in the Associate Division. Welcome to the following companies and their representatives:

**GENERAL DIVISION - A. T. Massey Coal Co., Inc.**, Richmond, VA, representative - Don L. Blankenship; **Beckley Smokeless Limited Liability Co.**, Beckley, WV, representative - John W. Stroud, Jr.; **Coal Cave, Inc.**, Glen Jean, WV, representative - Carmen D'Angelo; **Cumberland River Coal Co.**, Ragland, WV, representative - Gary L. Bennett; **J & B Coal Co.**, Uniontown, PA, representative - Bernard J. Bealko.

**ASSOCIATE DIVISION - Associates Commercial Corp.**, Cincinnati, OH, representative - John R. Conkin; **Cleco Corp.**, Rosedale, VA, representative - J.W. Harman; **Cultural Resource Analysts, Inc.**, Lexington, KY, representative - Charles M. Niquette; **Environmental Monitoring, Inc. (EMI)**, Coeburn, VA, representative - R. J. Porter; **Environmental Science & Engineering, Inc.**, Herndon, VA, representative - Eric B. Deaver; **GeoOne Service, Inc.**, Reynoldsburg, OH, representative - Steve Statler; **Long-Airdox Co.**, Oak Hill, WV, representative - Michael R. Hastings; **Luber-Finer**, Dallas, TX, representative - Jeffrey Frey; **Mineral Transport, Inc.**, Fairmont, WV, representative - William R. Snoddy; **Mining Services, International**, Ashford, WV, representative - Keith A. Duffy.



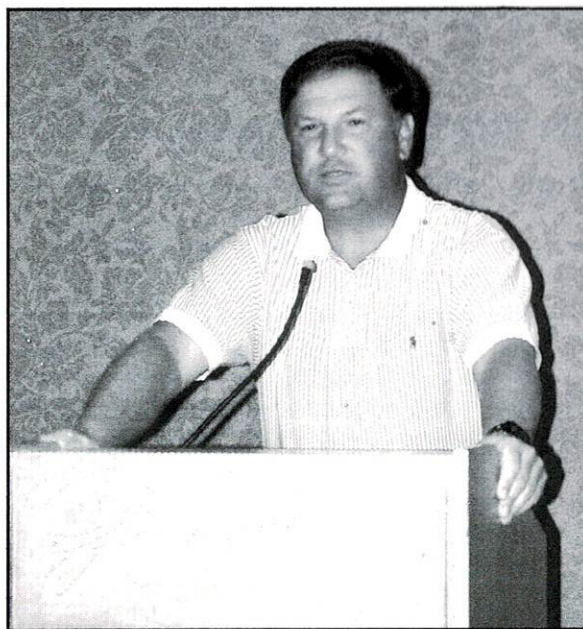


John Bryan had his whole family on hand for his farewell performance as Chairman. l-r John, Stephanie, John, III, Jenny and Mary.



Chairman Bryan received the traditional portrait as a tribute to his service to WVMRA.

## Scenes from *The Greenbrier*



Jim Donnan, Head Coach of Marhsall University's top ranked football team, entertained the Saturday morning breakfast crowd.



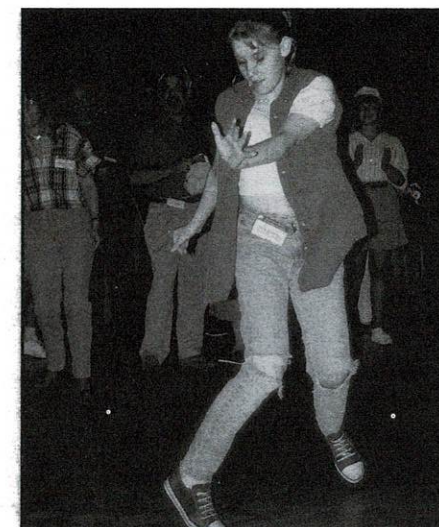
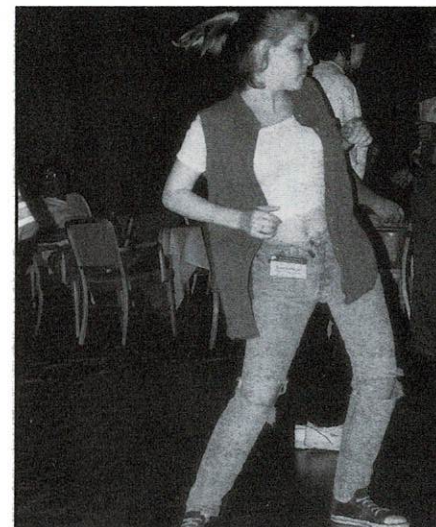
Steve Cvechko of Kimberly Industries teaches son John the finer points of Blackjack at "Monte Carlo Night."



John Fisher of WVU with Forest Roles of Smith, Heenan & Althen, Steve Walker of Walker Machinery and Buck Harless of Chafin Branch Coal.



Dan Pochick of Rish Equipment, Paul Goad of Juliana Mining, Bob and Marilyn Brenkman with Anderson of West Virginia.



Annie Scherder wowed the crowd with a dancing display that reduced aging baby boomers to a state of appreciative observation.



Ed Surgeon of Cummins Cumberland, Jenny Roberts of Penn Line Service and John Smith of Rudd Equipment.



Phil Cooper of Wind River Resources, Bob Frederickson of Walker Machinery and Jim Green of Ingersoll Rand.





'Buck's Bunch,' the four time champion of the General Division Company Pride Award.

## Repeat winners of 'Company Pride' Awards



DYNO NOBEL goes all out with 'Company Pride' and won its second straight award in the highly competitive Associate Division.



Austin Powder Co. provided its usual show of strength and flair to capture the silver lunch bucket in the Associate Division.



Anderson of West Virginia declared itself 'The A Team,' and nearly intimidated the judges into a bucket.

### 'Company Pride'

## *There's no such word of 'fourpeat' --- is there?*

If there were a retirement clause in the "rules" governing the Company Pride Awards at the Association's Annual Meeting, then surely the General Division Bronze Lunch Bucket would have a permanent home in Gilbert, West Virginia.

"Buck's Bunch," a loose coalition of Buck Harless associates, cemented its standing as 'the dominant "Company Pride" team of the '90's with an unprecedented fourth consecutive title in the General Division.

"Company Pride" awards are given in recognition of the pride of employment during WVMRA's Friday night "Coal Miners' Party," traditionally scheduled for rustic Kate's Mountain at The Greenbrier Gun Club. Contestants are judged on their display of company pride through tee-shirts, caps, etc. Creativity and sheer numbers also count very heavily.

Threatening skies once again forced the party indoors, but undaunted, "Buck's Bunch" showed up in full force and complete regalia to retain the top prize.

The runner-up spot went unclaimed for lack of competition. The two leading contenders were the Association staff, ruled ineligible on the grounds that none of them had ever mined a pound of coal, and outgoing Chairman John Bryan, of Pittston Coal who, on his last night of office, mounted an unsuccessful campaign to snag the silver bucket for himself.

In the Associate Division, things were a little more heated, but defending champion DYNO NOBEL Inc. overpowered a strong field of competition to hold on to its bronze bucket.

The Associate Division silver bucket went to a perennial power, the red-shirted, Aussie-hatted group from Austin Powder. Special recognition went to the biker clad "A-Team" from Anderson of West Virginia.

At the conclusion of a very successful evening, the following questions had gone unanswered.

Can anybody stop "Buck's Bunch"? Will anybody try? Does anybody remember what Kate's Mountain looks like?



The WVMRA staff recruited family, friends and former staffers to produce a formidable group, but was unable to pass the muster of unbiased judges, who ruled them ineligible.



# Annual Meeting Prize donors and sponsors

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## Prize Donations

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Austin Powder Company (Herm DeProspero) - \$50  
Foster Supply, Inc. (Chuck King) - \$50  
Mt. State Bit Service (Paul Laskody, Jr.) - \$50  
Mountain Explosives Company (John Bussey) - \$50  
Nelson Brothers (John Holliday) - \$50  
Robinson & McElwee (Joe Price) - Trophies  
Trojan Corporation (Jim Bertiaux) - \$50

### FISHING TOURNAMENT

ICI Explosives USA (Charlie Miller) - Rod & Reel  
Ingersoll-Rand Co. (Jim Green) - \$50  
Kanawha Steel & Equipment Co. (Cal Nelson) - \$100  
Mt. State Bit Service (Paul Laskody, Jr.) - \$50  
Nelson Brothers (John Holliday) - \$50  
Peter's Creek Coal Association (Mike Perilli) - Coolers  
Trojan Corporation (Jim Bertiaux) - \$50

### GOLF TOURNAMENTS

Beckwith Machinery (Dave Trueman) - \$100  
Carter Machinery Company (Roger Jetton) - Putter  
Crown Hill Equipment (Chris Supcoe) - \$100  
Cummins Cumberland (Dave Hibbs) - \$100  
Driltech, Inc. (Tim Murphy) - \$100  
DYNO NOBEL (Tim Zeli) - \$100  
Fairchild International (Jack Fairchild, Jr.) - \$100  
Fielding Hydroseeding, Inc. (Ed Brown) - \$100  
Flat Top Insurance Agency (Ardie McMillion) - \$100  
GH Hensley Industries, Inc. (Norman Duncan) - Putter  
Gilbert Distributing Company (Fred Harless) - \$100  
John Henry Rock Drills (Fil Nutter) - \$100  
Kanawha Steel & Equipment Co. (Cal Nelson) - \$100  
Miller & Miller Auctioneers  
(Bill Flynn) - \$100 Men & \$100 Ladies  
Morton Specialty Insurance (Charlie Morton) - \$100  
Mountain Explosives Co. (John Bussey) - \$100  
Mt. State Bit Service (Paul Laskody, Jr.) - Blaster's Lamp  
Penn Line Service, Inc. (Larry Roberts) - \$50  
Petroleum Products, Inc. (Tom Taylor) - \$100  
Rudd Equipment Company (John Smith) - \$200  
Team DYNO" (John Bussey, Paul Laskody, Jr., Larry Shradar, Rick Tankersley & Tim Zeli) - Beer Carts  
Union Carbide Corp. (John Rader) - Trophy  
Vencill Corp. (Delmer & Ernest Vencill) - \$100  
Worldwide Equipment Co. (Mike Null) - Zebra Putter

### CHILDREN'S PUTTING TOURNAMENT

Austin Powder Company (Tim Warden) - Trophies  
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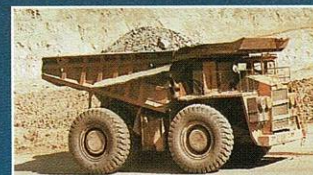


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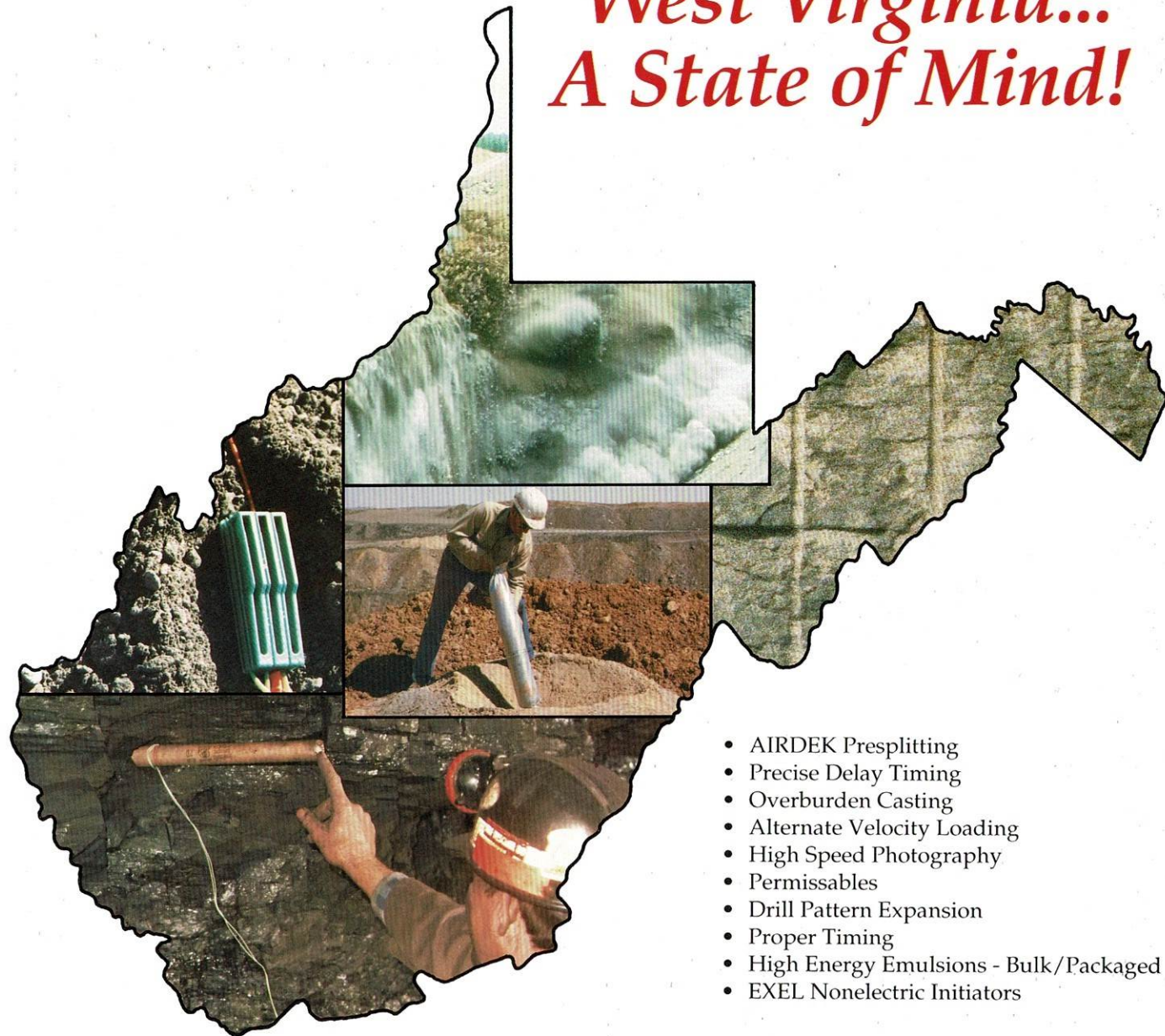
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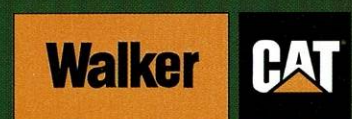
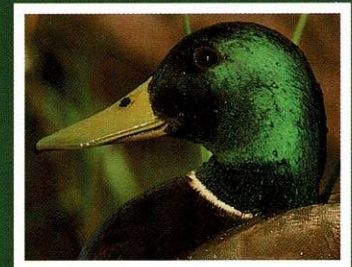


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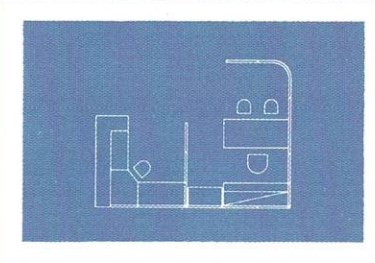
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## Mine profile — Wylo

Company	Arch of West Virginia, Inc.
Mine	Wylo Surface
Location	7 miles east of Man on Route 16 in Logan County
Active Permits	five permits 13-76, 159-74, S-68-85, S-5035-86, S-5069-92
Bonded Acreage	3,142
Employees	117
Annual Production	2 million tons
Life of Operation	11 years from 1987
Mining Method	Mountaintop removal
Equipment Spread	53 yard shovel, five 240 ton overburden trucks, three 200 ton overburden trucks 28, 13 & 7 yard loaders, contractor coal haulage trucks
Coal Seams	Stockton, 3 feet; Coalburg, 8 feet
Coal Characteristics	2 x 0 product; 12,000 btu, 12 ash, 0.8 sulfur, 6% moisture
Cleaning Plant	coal trucked to central AOWV cleaning plant with 650 tons per hour capacity
Transportation	70% of production by CSX rail through Fanco unit train loadout facility, remainder by truck to Big Sandy Terminal near Kenova for barge loading
Market	Electric utilities, primarily in Kentucky, Ohio, Maryland, Georgia
Post Mining Land Use	Recreational, forestry, farm, hayland, pasture land, wildlife habitat





Wylo's 53 yard shovel works in conjunction with 240 ton rock trucks to uncover the Stockton and Coalburg seams.

## Wylo was the starting point for AOWV

Arch of West Virginia was formed in 1987, when Arch Mineral Corp. purchased the reserves and assets of Diamond Shamrock, which had previously bought out Amherst Coal Co.

The established centerpiece of the original AOWV assets was the Wylo mine at Lundale, as well as the newer Ruffner mine at Yolyn, both in Logan County. The company later acquired properties from Valley Camp Coal Co.

In Wylo, AOWV inherited an excellent workforce. It also took on a mountaintop mining operation which was more mining than reclamation, at a time when regulators were implementing an increased concentration on contemporaneous reclamation.

Several years of catchup reclamation culminated last winter when AOWV won a Reclamation Award for its work on the "Abe Burgess Refuse Area."

Arch presently holds 52,000 acres of coal reserves in Logan, Kanawha and Wyoming counties in southern

West Virginia. The majority of its production comes from Wylo and Ruffner, supplemented by contractor operated underground mines.

Arch of West Virginia is a division of Apogee Coal Company, which, in turn is owned by Arch Mineral Corp., one of the largest mining companies in the U.S. The company currently employs a direct workforce of 524.

Wylo is well known for its outstanding safety record. A traditional winner of the "Mountaineer Guardian" award for fatal free production, Wylo also won the "Milestones of Safety Award" in 1993. The mine was recognized for its enviable record of working 19 months, over 400,000 manhours, without a lost time accident, including 351 consecutive days with no reportable accidents.

At the end of 1992, Wylo's workforce completed a full 20 years of operation and production of over 12 million tons, without a fatal accident. With production having doubled over the last seven years, the mine's record now stands at 22 years without a fatality.



Like its sister mine, Ruffner, Wylo uses end dump valley fills for excess overburden disposal.



Wylo is already well along toward its eventual use as a rangeland and wildlife habitat.





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# Open limestone channels for treating acid mine drainage: A new look at an old idea

By Paul Ziemkiewicz, Jeff Skousen, and Ray Lovett  
West Virginia University

## Introduction

Much effort has been devoted to the development of low cost, low maintenance methods for treating acid mine drainage (AMD). Two methods and their various combinations have been successfully applied: constructed wetlands and anoxic limestone drains (ALD). These methods, however, do not work in all situations. Unless large acreages of land are available to ensure adequate residence time for the AMD, wetlands are limited to treating rather mild acidities and modest flows. Given the mountainous terrain of the Appalachians, opportunities for large wetlands are few.

Anoxic limestone drains are beds of crushed limestone from which oxygen is excluded, and AMD is intercepted underground and introduced into the bed of limestone. Ideally, ALD's operate at an internal pH of 6.3, the buffer pH of bicarbonate ion and carbonic acid. Since reduced (ferrous) iron will not precipitate at this pH, it will pass through the drain. The whole point of the ALD is to prevent oxidized, ferric hydroxides (the familiar orange floc) from coating (armoring) the limestone, and to add alkalinity through limestone dissolution. It is generally believed that armored limestone ceases to dissolve and no longer treats acid to any significant extent. Even without ferric iron armoring, aluminum hydroxides will precipitate at a pH above 4.5 regardless of whether the water is anoxic or not.

ALD's are capable of treating high acid loads over relatively short distances and can be designed into sloping terrain. However, they are delicate systems, and even without introduction of oxygen, aluminum hydroxides will precipitate within the drains. If internal water velocities are too slow to carry the aluminum hydroxides (white floc) out of the drain, it will eventually plug, forcing incoming water to blow out the top of the drain and exit at the upstream end. If any ferric iron appears in the drain, it will precipitate as orange floc, adding to the clogging problem. If sulfate is present in concentrations much above 2000 ppm, it will start to precipitate as gypsum.

So in theory, ALD's work fine if the AMD has no aluminum, no ferric iron, a sulfate level below 2000 ppm, or an internal

flow rate fast enough to flush the resulting precipitates out of the drain. In order to minimize the overall size and cost of the drain, most ALD designs try to maximize residence time by slowing down the flow of water. Sometimes ALD's consist of a series of basins connected by riser pipes. These basins, in turn, are very efficient in trapping any metal precipitates generated by the drain contributing to the clogging problem.

ALD's and wetlands will continue to play an important role in passive treatment, and ongoing research will resolve many of the current problems. This article revisits a simpler alternative to the ALD, the open limestone channel (OLC), and gives some reasons and situations where such a system might be appropriate.

## Open Limestone Channels

The idea behind the open limestone channel lies in the proposition that even armored limestone will continue to dissolve in acid water at some predictable rate (Figure 1). An open limestone channel is just as its name implies: an open, free-flowing channel lined with coarse limestone (i.e. > 4 in. diameter). The key question to be answered is at what rate does limestone dissolve after armoring. Then, what is the length of the channel and the tonnage of limestone needed to treat a particular AMD stream?

A series of studies conducted in the early 1970's by Penn State researchers (Pearson and McDonnell, 1974, 1975a, 1975b, 1977, 1978) evaluated the potential of crushed limestone as a passive treatment. The rate of limestone dissolution under AMD loadings was determined and the effect of iron hydroxide armoring was identified. The results, based on two years of field observation, concluded that fully armored limestone is 1/5 as soluble as unarmored limestone. This factor, combined with the identified dissolution rate in an AMD setting, allows us to estimate the length of a drain and the tons of limestone necessary to treat a specific acid load. This information is summarized in Table 1.

**Table 1.** Construction criteria of open limestone channels for treating AMD\*. The calculations are for a stream cross-section of 3 ft deep by 10 ft wide and an acidity concentration of 1000 mg/l, and assumes that limestone will dissolve at 20% maximum efficiency when armored. Under the given conditions, the data estimate the length of a channel and the tons of limestone which will provide 90% neutralization of the acidity over a 1 hr residence time or 100% neutralization after 3 hours residence time.

Conditions Flow gpm	Velocity ft/sec	1 or 3 hrs Contact Time Channel Length (ft)		1 or 3 hrs Contact Time Tons of Limestone			
		90% Neutralization		100% Eff		20% Eff	
		1 hr	3 hr	1 hr	3 hr	1 hr	3 hr
100	0.02	67	201	169	508	847	2542
200	0.04	134	401	339	1017	1695	5085
300	0.06	201	602	508	1525	2542	7627
400	0.07	267	802	678	2034	3390	10170
500	0.09	334	1003	847	2542	4237	12712
600	0.11	401	1203	1017	3051	5085	15254
700	0.13	468	1404	1186	3559	5935	17797
800	0.15	535	1604	1356	4068	6780	20339
900	0.17	602	1805	1525	4576	7627	22882
1000	0.19	669	2006	1695	5085	8475	25424

\*From Pearson and McDonnell, 1974.

For example according to the table, an acid source of 100 gpm with 1000 mg/l acidity would be 100% treated by armored limestone with a 201 ft channel containing 2542 tons of limestone. To obtain 90% neutralization with armored limestone, the channel would have to be 67 ft long with 847 tons of limestone. Unarmored limestone would neutralize 90% of the acidity in a 67 ft channel containing 169 tons of limestone.

The limestone beds in these studies were constructed as permeable dams across streams. This construction technique allowed leaves, sediment and other debris to accumulate on the upstream side of the dams resulting in

water passing over, rather than through them.

In addition to the above studies, the authors recently conducted a survey of abandoned mine land sites in northern West Virginia where channels of open limestone were used to conduct acid water from the sites (Table 2). These channels were only built for water conveyance and erosion control, and no particular AMD treatment benefit was expected. Water flows and slopes were estimated at each site, and water samples were taken at various points along the length of the channel. The samples were analyzed for pH, acidity, alkalinity, Fe, Mn, Al, Ca, Mg, and SO<sub>4</sub>.

**Table 2.** General characteristics of open limestone channels sampled in our study.

Site	County	Coal Seam	Length (ft)	Slope (%)	Flow (gpm)	Character
Brownston	Barbour	Pittsburgh	500	30	350	Grouted LS
Dola	Marion	Pittsburgh	700	10	25	Grouted LS
Florence	Harrison	Pittsburgh	700	15	60	70% SS, 30% LS
Webster	Preston	Up Freeport	1500	25	80	Anoxic LS
Airport	Monongalia	Pittsburgh	100	10	50	Ungouted LS

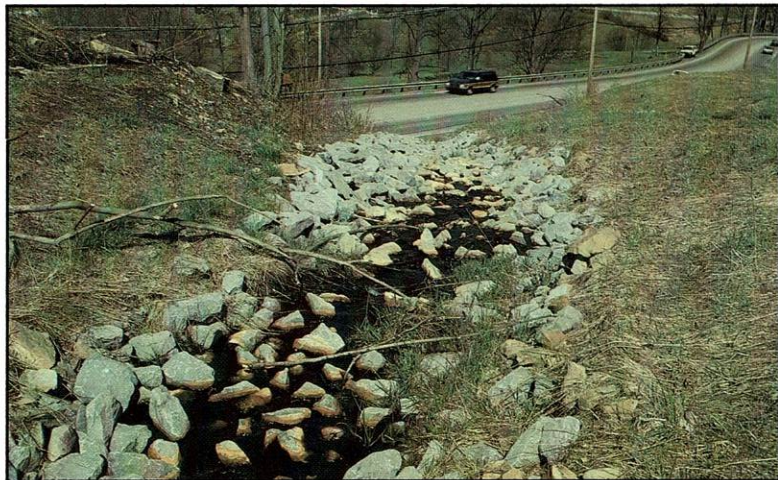




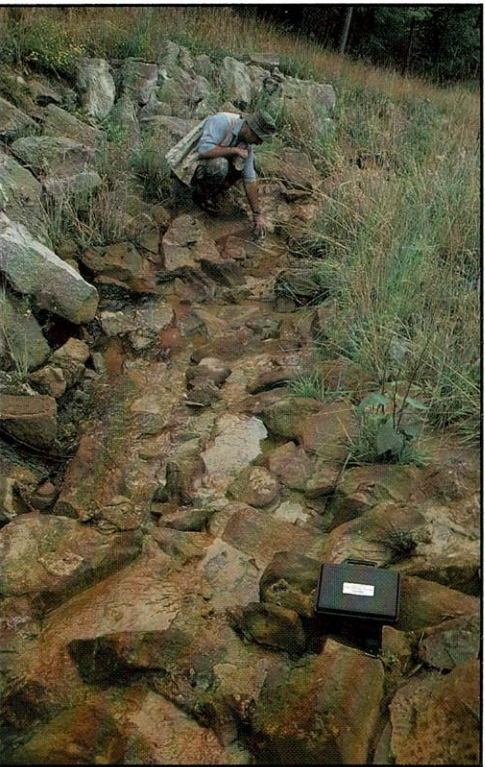
**Figure 1.** Many open limestone channels which convey acid mine drainage are armored by iron precipitates. Many people assume that armored limestone will provide no treatment to the acid drainage.



**Figure 2.** The open limestone channel on the Brownton AML site. This channel is about 500 ft long and is covered with ferric hydroxides.



**Figure 3.** An open limestone channel near the Morgantown Airport. Water pH is 2.8 and little treatment occurs from this short limestone channel.



**Figure 4.** Constructing open limestone channels on steeply-sloping regions in a stream or drain will keep metal flocs from burying the limestone.

**Table 3.** Water quality from grouted limestone OLCs on Brownton and Dola AML sites in West Virginia

Site	Ft from Top	pH	Acid	Alk	Fe	Mn	Al	Ca	Mg	SO <sub>4</sub>
<b>Brownton</b>										
	0	5.6	10	90	28	3	0	185	67	854
	100	6.0	0	63	27	3	0	187	66	854
	200	6.1	0	60	25	3	0	187	64	827
	400	6.2	0	53	24	3	0	187	64	827
	500	6.3	0	55	22	3	0	208	65	849
% Change			-100	-39	-21	0	0	12	-3	-1
<b>Dola</b>										
	0	6.0	154	101	162	28	3	483	129	2263
	100	6.1	219	28	152	34	2	475	137	2192
	400	6.5	0	81	35	24	0	552	135	2227
	700	6.6	0	231	32	11	0	519	126	1629
% Change			-100	56	-80	-61	-100	7	-2	-28

### Results and Discussion

Water pH and calcium both increased as expected on the grouted limestone channel at Brownton (Table 3). Iron also showed a small decrease, but alkalinity declined. This could be attributed to the ferrous iron oxidizing to ferric iron and thereby creating acidity. This site is very steep and has a very high flow of water (Figure-2).

The water passing over the Dola OLC increased in pH (6.0 to 6.6) and alkalinity (from 53 mg/l net acidity to 231 mg/l of alkalinity). Iron was reduced by 80%, manganese by 61%, and calcium was slightly increased by 7%. This OLC appears to have a dramatic influence on the water quality.

The Florence site conveyed water from two deep mine portals through an open, ungrouted sandstone/limestone channel. The water pH was 6.2 to start with and increased to 7.8 after 600 feet (Table 4). The small amount of iron in the water was removed from the water, but no increases were noted for calcium and magnesium. The improvement in water pH would normally be attributed to the limestone in the channel, however calcium and magnesium concentrations would also have been expected to increase.

**Table 4.** Water quality from an ungrouted 70% sandstone and 30% limestone OLC on the Florence AML site in West Virginia.

Site	Ft from Top	pH	Acid	Alk	Fe	Mn	Al	Ca	Mg	SO <sub>4</sub>
<b>Florence</b>										
	0	6.2	0	229	6	0	0	388	75	986
	155	6.5	0	221	1	0	0	375	73	915
	160	5.8	19	45	29	0	0	283	71	854
	360	6.9	0	200	0	0	0	375	70	1002
	460	7.0	0	201	0	0	0	374	71	986
	660	7.8	0	189	0	0	0	368	73	1024
% Change			0	-17	-100	0	0	-5	-2	4



The Webster AML site is unique in that it drains three Upper Freeport deep mine portals and conveys the water through pipes almost 1000 feet before it empties into a traditional anoxic bed of limestone. The pH of the water taken from two manholes above the anoxic bed of limestone was around 3.0, with acidity measured between 100 and 300 mg/l (Table 5). After contacting the limestone, the pH increased to 6.6 and alkalinity rose to 137 mg/l. Calcium increased by 450%, while iron, manganese, and aluminum were all removed.

Two sites near the Morgantown Airport drain deep mine drainage of poor quality (Figure 3). The pH of the water at both sites was 2.8, and no change was made after flowing down the channel (Table 5). Acidity decreases were small,

and some decrease in iron concentrations was found. The results were somewhat surprising in that predictable, consistent, albeit slow acidity reduction was observed on these sites. Some of the drains achieved 100% acidity reduction. All these limestone channels were relatively short (<800 ft), and the Webster drain had limestone only at the bottom in a cell. Most of them were exposed to mild AMD. Only the Webster site achieved 100% treatment of a strongly acid source.

The Morgantown Airport drains had the most acidic water and they were the shortest. Extrapolation of the observed treatment rates to 100% suggests that lengths of 2000 to 2200 ft would likely be effective in neutralizing this AMD.

Table 5. Water quality from ungrouted limestone OLCs at Webster and near the Morgantown Airport AML sites in West Virginia.

Site	Ft from Top	pH	Acid	Alk	Fe	Mn	Al	Ca	Mg	SO <sub>4</sub>
Webster	80	3.0	104	0	7	1	7	102	35	352
	700	2.7	284	0	19	7	22	373	117	1330
	(after LS)	1300	6.6	137	0	0	0	561	120	1395
	% Change		-100	100	-100	-100	-100	450	241	296
Airport 1	0	2.9	356	0	55	3	26	103	41	726
	50	2.9	341	0	49	3	26	102	41	726
	60	2.8	333	0	48	3	26	102	41	730
	70	2.8	330	0	47	3	27	101	40	727
	80	2.8	322	0	43	3	27	99	40	731
	90	2.8	329	0	44	3	27	101	41	741
	% Change		-8	0	-20	0	2	-2	0	3
Airport 2	0	2.7	410	0	39	2	28	99	36	710
	30	2.7	394	0	37	2	28	101	36	721
	60	2.7	388	0	35	3	27	103	36	728
	90	2.8	376	0	33	3	27	107	36	712
	120	2.8	363	0	31	3	28	108	37	717
	150	2.8	361	0	30	3	27	108	37	704
	% Change		-12	0	-23	33	-4	8	3	-1

Practical Application

While the lengths calculated in Table 1 might not be practical in active mining operations, open limestone channels could be an inexpensive pre-treatment step if placed upstream of a conventional treatment system. Pearson and McDonnell (1974) found that 3.5 minutes of residence time, even in armored limestone, neutralized 50% of the initial acidity.

AML and other watershed restoration programs would benefit from open limestone channels. If properly constructed to withstand washout during high flows, they should be nearly maintenance free. In many instances, open limestone channels could be built by simply lining existing stream channels. Most watershed restoration programs have the several thousand feet of channel necessary for constructing these open limestone channels.

Since open limestone channels will cause precipitation of ferric and aluminum hydroxides, they should be constructed on the steeper parts of a stream or drain. The higher water velocities will tend to carry the flocs downstream, thereby minimizing armoring or sludge deposition on the limestone (Figure 4). If limestone is placed in flat-lying stretches with low currents, the limestone obviously will be buried under the precipitating metal floc. Based on our observations, burial is a more significant

problem than armoring. While armoring usually generates a 1/16 to 3/8 inch layer of hydroxides, sediment buildup can bury the crushed limestone under a foot or two of metal sludge, isolating it from the acid water.

The water flowing down or coming out of an open limestone channel will look very polluted. The water will carry enough suspended ferric hydroxide to be very orange even though the pH might be 7. So it would normally be wise to plan the construction of a settling basin below the channel to clarify the water prior to discharge. In a watershed restoration project, the basin could take the form of a wetland or simply an open pond that is sized to accept the volume of floc expected from the water. The pond or wetland would not be expected to provide any chemical treatment. Its only purpose would be to slow the water enough to drop out the suspended iron and aluminum hydroxides.

Open limestone channels will not be appropriate in every situation. But where rapidly-flowing water is moving along a long and sloping incline, an open limestone channel has the potential to reduce acid loadings simply and inexpensively. Research at the National Mine Land Reclamation Center at West Virginia University is continuing to evaluate the large-scale application of this method.

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# COAL CALENDAR

## October

21-22 **West Virginia Mining & Reclamation Association, Fall Meeting**, Lakeview Resort & Conference Center, Morgantown, WV, contact Patty Bruce, WVMRA, 1624 Kanawha Boulevard East, Charleston, WV 25311, (304) 346-5318, FAX 346-5310.

## November

8-10 **4th Symposium on Respirable Dust in the Mineral Industry**, University Park, PA, contact R. V. Ramani, Penn State University, 104 Hosler Bldg., University Park, PA 16802, (814) 865-3437.

## January

8-10 **Mine Blasting & Safety Seminar, MSHA Academy**, Beckley, WV, contact Mac Carnes, MSHA Academy, P. O. Box 1166, Beckley, WV 25802, (304) 256-3398, FAX 256-3299.

10-12 **22nd West Virginia Mining Symposium**, Holiday Inn - Charleston House, Charleston, WV, contact Patty Bruce, WVMRA, 1624 Kanawha Boulevard East, Charleston, WV 25311, (304) 346-5318, FAX 346-5310.

## February

31-5 **West Virginia Mining & Reclamation Association, Semi-Annual Meeting**, Aruba Hyatt Resort & Casino, Aruba, contact Patty Bruce, WVMRA, 1624 Kanawha Boulevard East, Charleston, WV 25311, (304) 346-5318, FAX 346-5310.



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## Association Notebook

### We lose Eddie Wiles

West Virginia and the coal industry suffered the loss of one of its most enduring supporters when an airline disaster claimed the life of Edwin K. Wiles, former President of the West Virginia Coal Association.

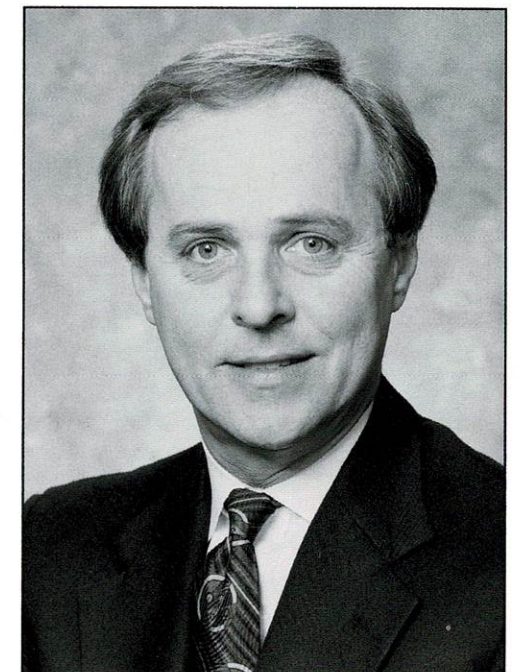
Just 50 at the time of his death, Eddie was the Northern Vice President of the Center for Energy & Economic Development (CEED). He was headquartered in Pittsburgh. Association friends had one last opportunity to visit with Eddie in early August when he appeared on the program for WVMRA's Annual Meeting at The Greenbrier.

A native of Tunnelton, in Preston County, Eddie was a journalism graduate of West Virginia University and a lifelong fan of the Mountaineers. Following graduation he worked for the *Morgantown Dominion-News*, then as the statehouse correspondent for Associated Press. He left that post for a position in the administration of Governor Arch Moore.

Eddie joined WVCA in 1970 and served as President of that organization from 1974 to 1985. After a stint as a business consultant in Charleston, he accepted a position in Pittsburgh with Chambers Development Co. He joined CEED in August of 1993.

WVMRA President Ben Greene, a Wiles colleague for many years, described the magnitude of the loss to the coal industry. "This is a tragedy on a very personal level for everyone who knew Eddie Wiles. Eddie was an articulate and effective spokesman for the coal industry for many years. More importantly, he was a friend to virtually everyone with whom he came in contact. You cannot replace people like him, either professionally or personally. Our hearts go out to Sheri and to his children."

Memorial services were conducted in Pittsburgh and Charleston to accommodate Eddie's countless friends and family well wishers



Edwin K. Wiles  
1944-1994

A scholarship endowment fund has been established at WVU in Eddie's memory.

The family has suggested donations to the scholarship fund in lieu of flowers. Contributions should be directed to Edwin K. Wiles Athletic Scholarship, WVU Foundation - AEF, P. O. Box 877, Morgantown, WV 26507.

### 'Mystery donor' identified

One of many, many prizes given out at the Annual Meeting was a portable compact disc player, presented as a "name tag drawing" gift at the closing banquet. Until recently, the donor of this prize was unknown.

However, the mystery is solved and due credit is hereby given to Ed Brown of Fielding Hydroseeding, Inc., Wharnclyffe, for his generosity. Thanks again to all those who donated prizes to make the Annual Meeting more memorable for all.

### Upcoming events

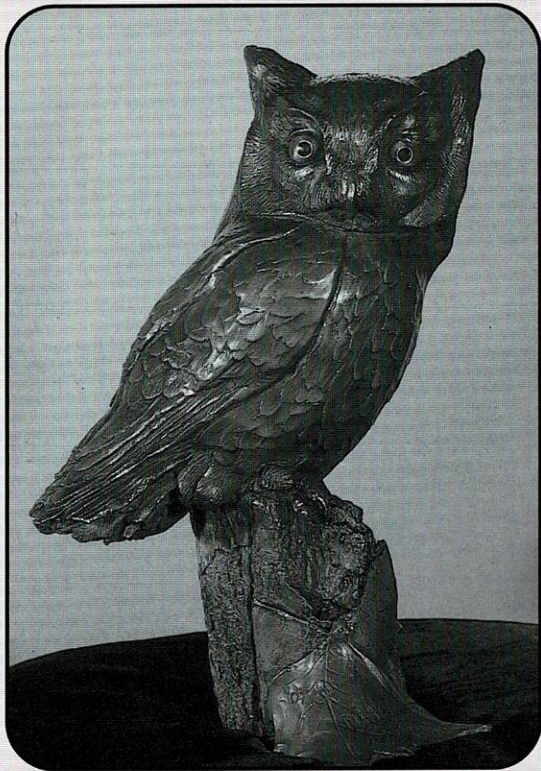
Members will want to mark their and make plans calendars for the following Association events:

**January 10-12** - 22nd Annual West Virginia Mining Symposium, "the most informative two days in mining," along with presentations of the Mountaineer Guardian and Reclamation Awards.

**January 31- February 5** - Semi-Annual Meeting and an escape from winter to the beautiful Caribbean port of Aruba.

**August 3-6** - Annual Meeting at The Greenbrier.





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Dave Jones, master wildlife sculptor and owner of Wildthings Sculpture Studios in Lewisburg, has captured the charm of this diminutive raptor in bronze, the first of an annual series designed to raise funds for West Virginia's Nongame Wildlife and Natural Heritage Program. A limited edition of 200 screech owls will be cast and sold solely to benefit the Program, which has the responsibility of the conservation and monitoring of more than 90% of West Virginia's wildlife. The money raised from the sale will be placed into the West Virginia Wildlife Endowment Fund to work in perpetuity for nongame and endangered species.

Each 10-inch bronze sculpture has a purchase price of \$335 (including shipping), of which the West Virginia Wildlife Endowment Fund will receive \$130 for the Nongame Wildlife and Natural Heritage account. A tax advisor should be consulted regarding the personal deductibility of this contribution. Each signed and numbered piece will be sold with

a certificate of authenticity and a letter confirming your contribution to the future of West Virginia's wildlife.

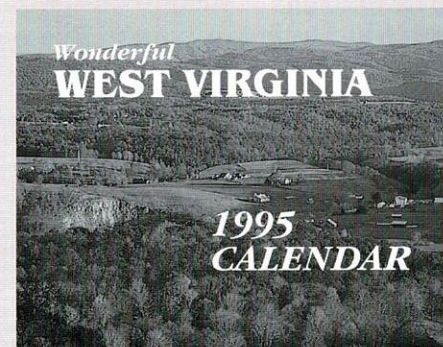
You may order your screech owl by sending a \$335 check for each sculpture to: Wildthings Sculpture Studios, P.O. Box 641, Lewisburg, West Virginia 24901. Telephone: (304) 647-5418.

## Coming Soon...

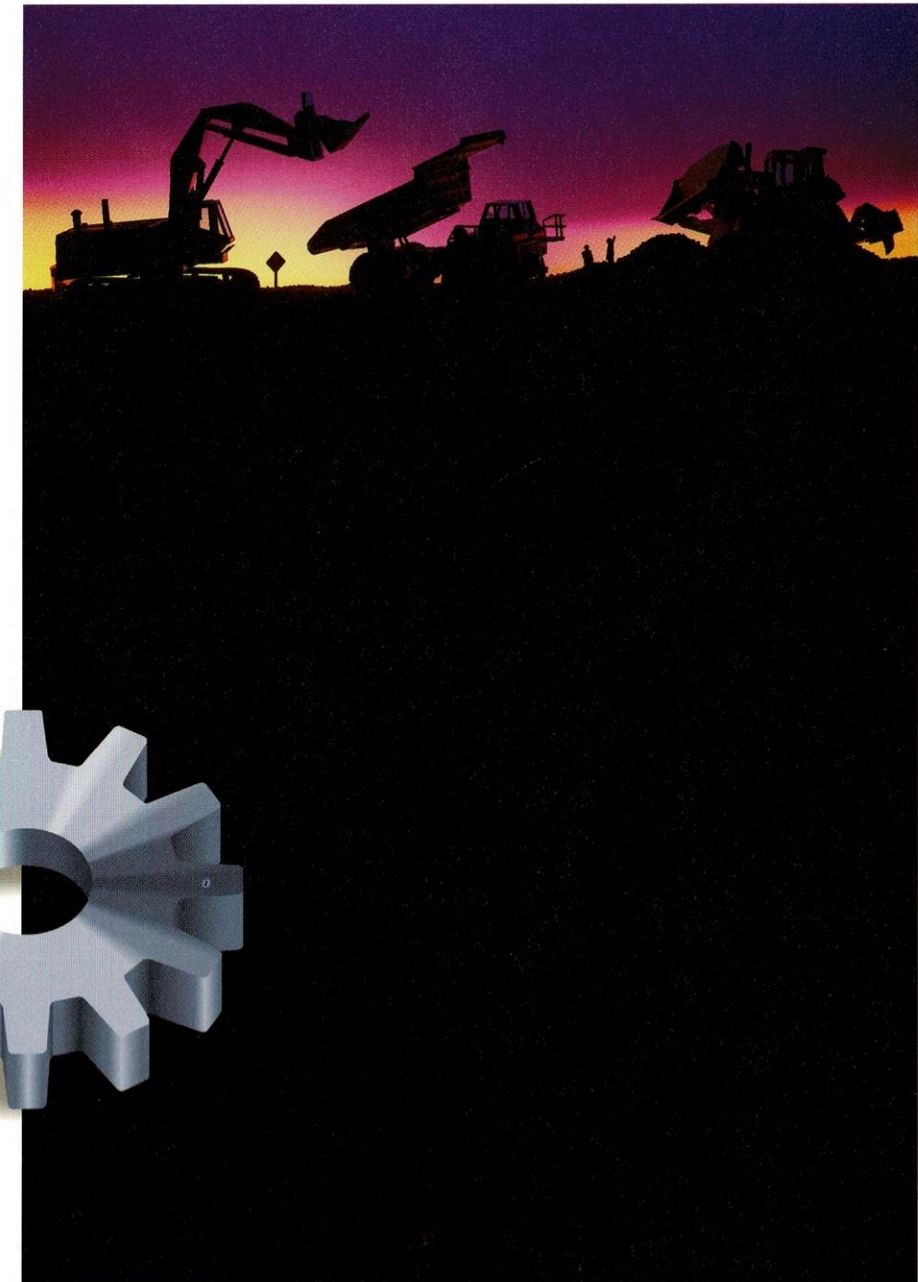
*Wonderful West Virginia* Magazine's 1995 Calendar will be off the press in the near future. Twelve scenic photographs of West Virginia—a different one each month—will show the four seasons at different places around the state. As each photograph will have its own color-coordinated border and will be printed on good-quality paper, the pictures will be suitable for framing. The size of the pages, 14 by 11 inches, will be larger than our 1994 calendar, so there will be even more space for you to write daily reminders.

This 1995 calendar will make a fine gift for your friends, family members, and business associates throughout the world. For an even nicer gift, why not combine a calendar with a year's subscription to *Wonderful West Virginia* magazine?

Complete details and ordering information will be provided in our October issue.



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