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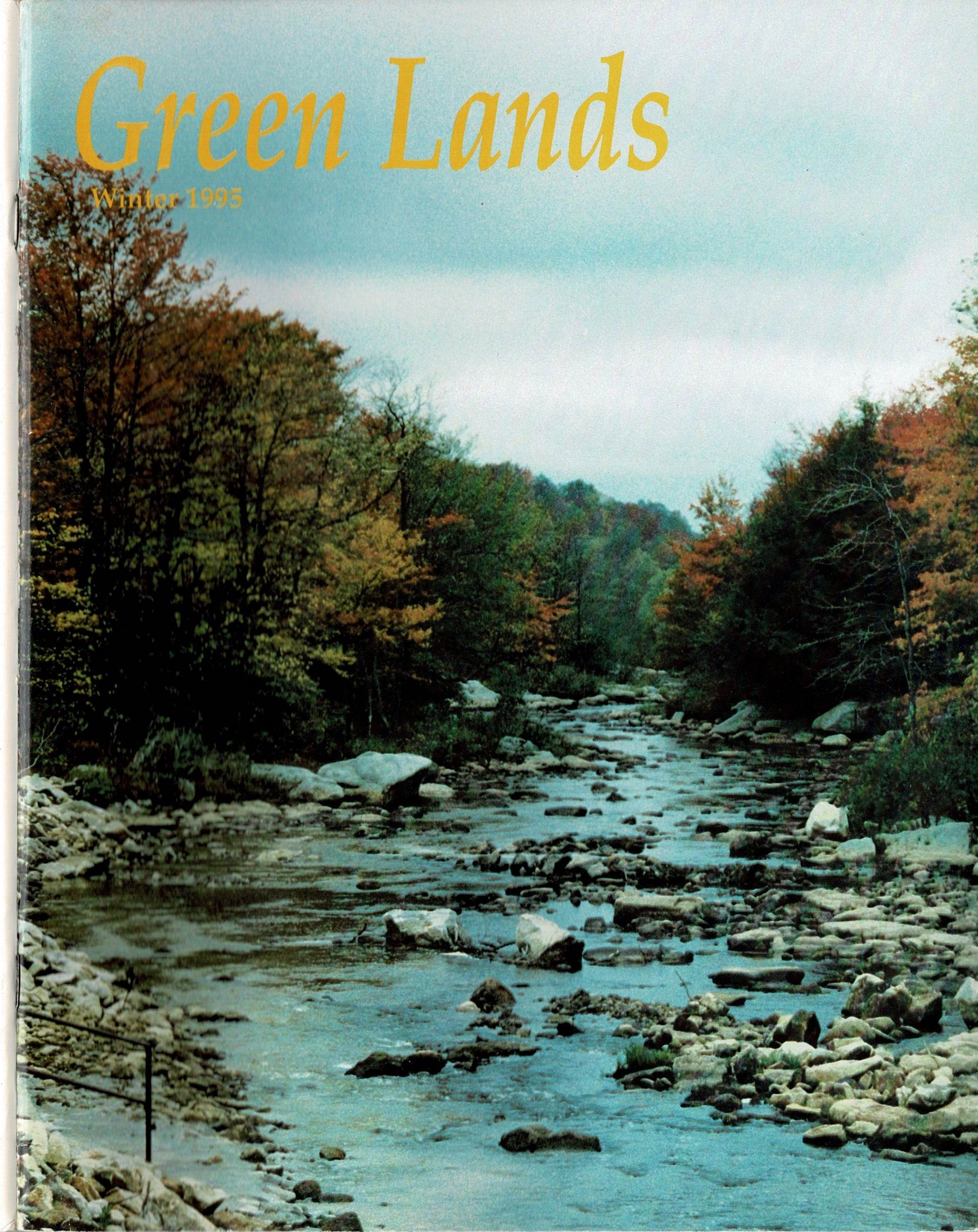

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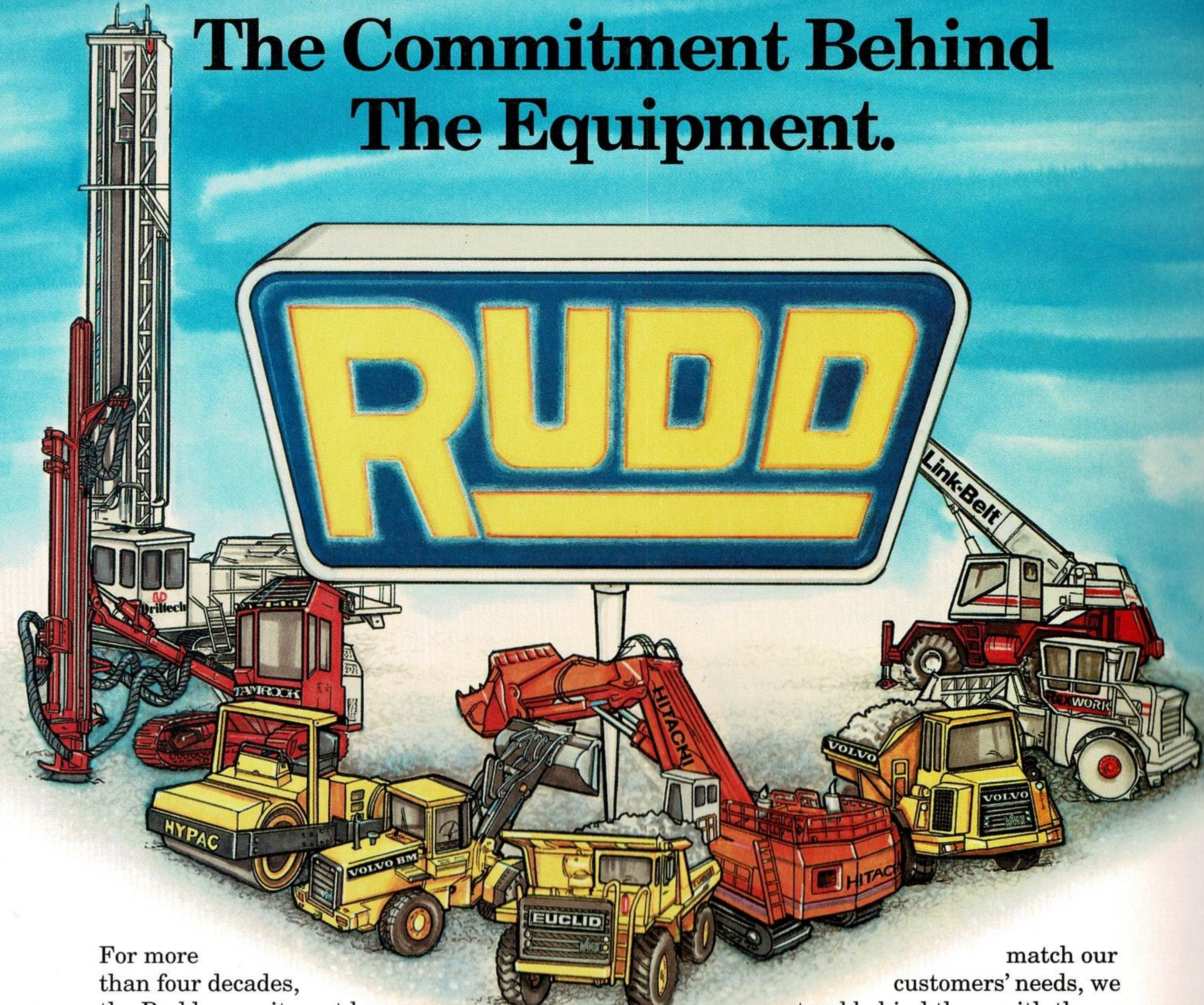

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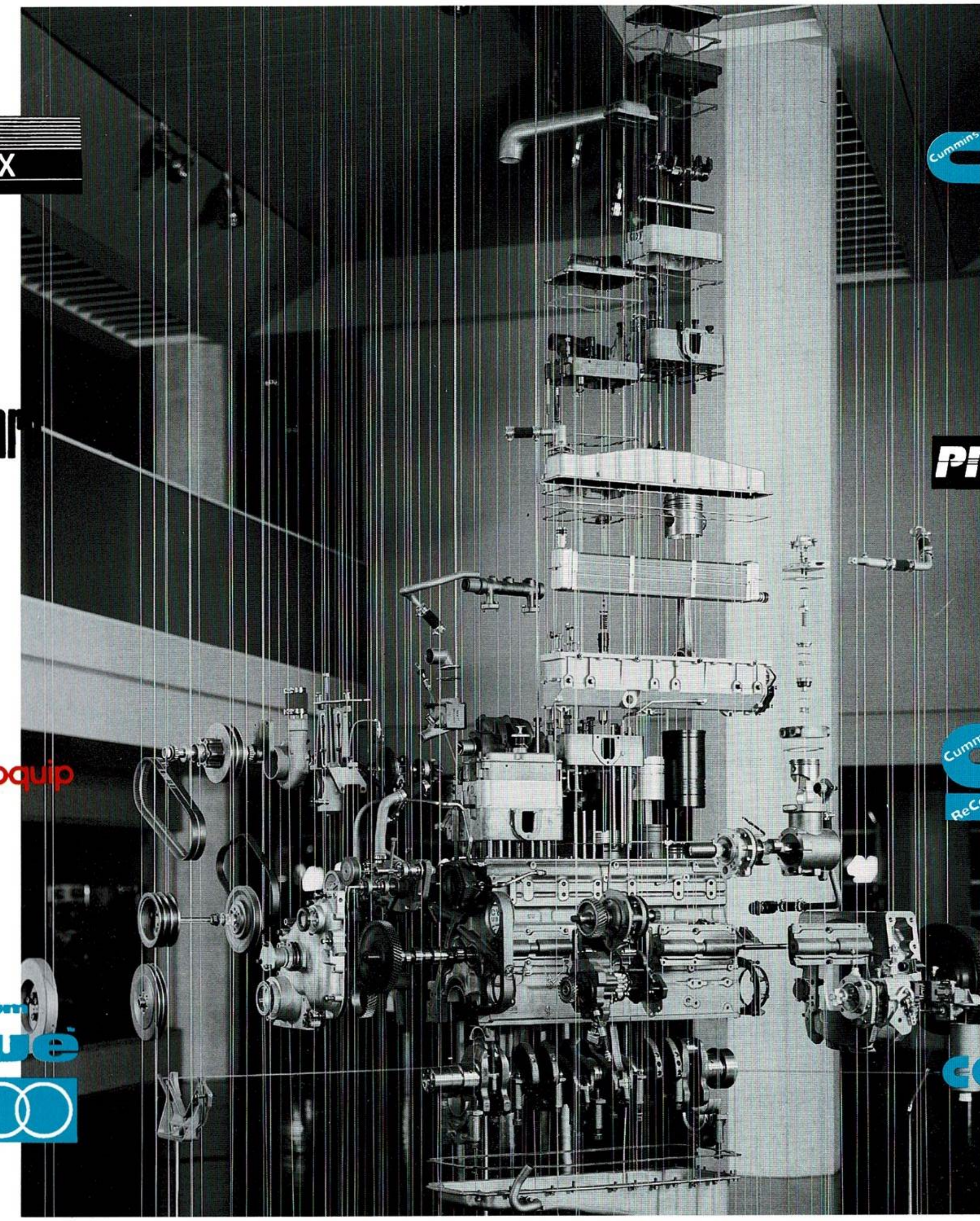

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Our Cover
The scenic Blackwater River in northeastern West Virginia is again "environmentally friendly," thanks to a limestone treatment facility constructed with AML funds.
Our cover story begins on page 8.

Index to Advertisers

This million dollar Limestone Station has effectively restored several miles of the Blackwater River. Other outstanding examples of AML work in the past year appear on the following pages.

AML program emphasizes water quality

West Virginia's Abandoned Mine Lands program has developed a certain consistency, collecting regular appropriations from the federal government, and putting West Virginians to work improving the environment, all at no cost to the taxpayer.

Specific projects are planned, bid and carried out according to a priority list of criteria established by the original Surface Mining Control Act. From a practical standpoint, this has meant that the lion's share of the funds have gone to reclaim the hundreds of coal refuse piles that dot West Virginia's landscape.

Recently, however, AML has diverted more attention and funding to water quality situations. An outstanding example is the Blackwater River Limestone Station which was dedicated in late September. Constructed with more than $1 million in AML funds on the banks of the Blackwater River in scenic Tucker County, the station was designed to raise the pH of six miles of the river, which had suffered from acid drainage from old upstream abandoned mines.

"This facility has succeeded beyond our most optimistic expectations," said West Virginia AML Chief Pete Pitsenbarger. "We were able to measure the effects within a week after the facility went into operation, and the pH now stands between 6 and 7, squarely in the middle of the neutral range. The treatment also extended much further downstream than we anticipated."

The station, which is powered by stream flow, contains six drums which feed limestone directly into the river at a rate dictated by the force of the water flowing through it. According to Pitsenbarger, the station is monitored daily, but could operate unmanned for a week.

The federal Office of Surface Mining has been collecting 35¢ a ton on surface mined coal and 15¢ a ton on underground production since 1977. The State AML program is funded by federal "grants" amounting to about half of the taxes collected from state mining operations. Each year the AML Section of the West Virginia Division of Environmental Protection formally applies for its share of the funds for construction (reclamation), administration and emergencies, as well as specific funds for acid mine drainage treatment and for water quality in general. In fiscal year 1994, the grant was for $25.9 million. This year, State officials are confident of receiving the full application of $31.5 million.

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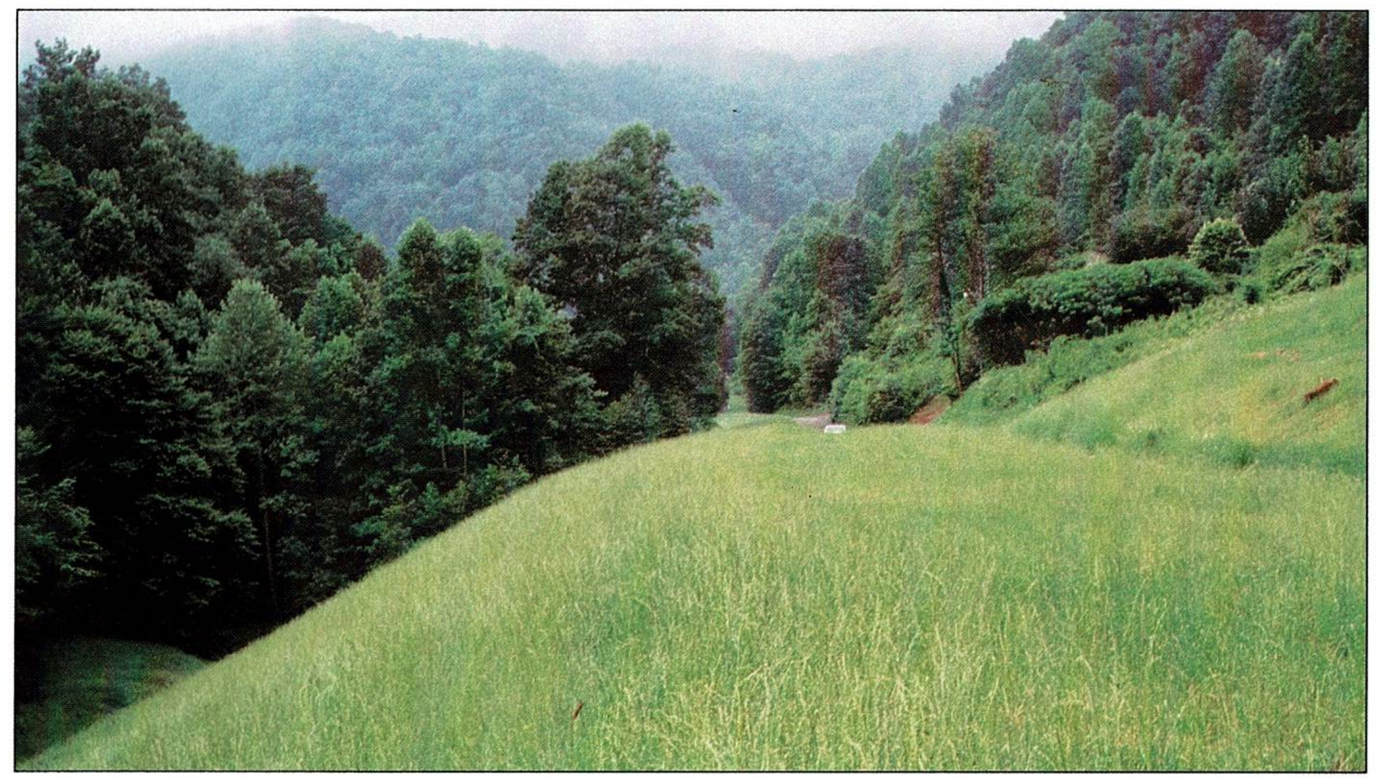

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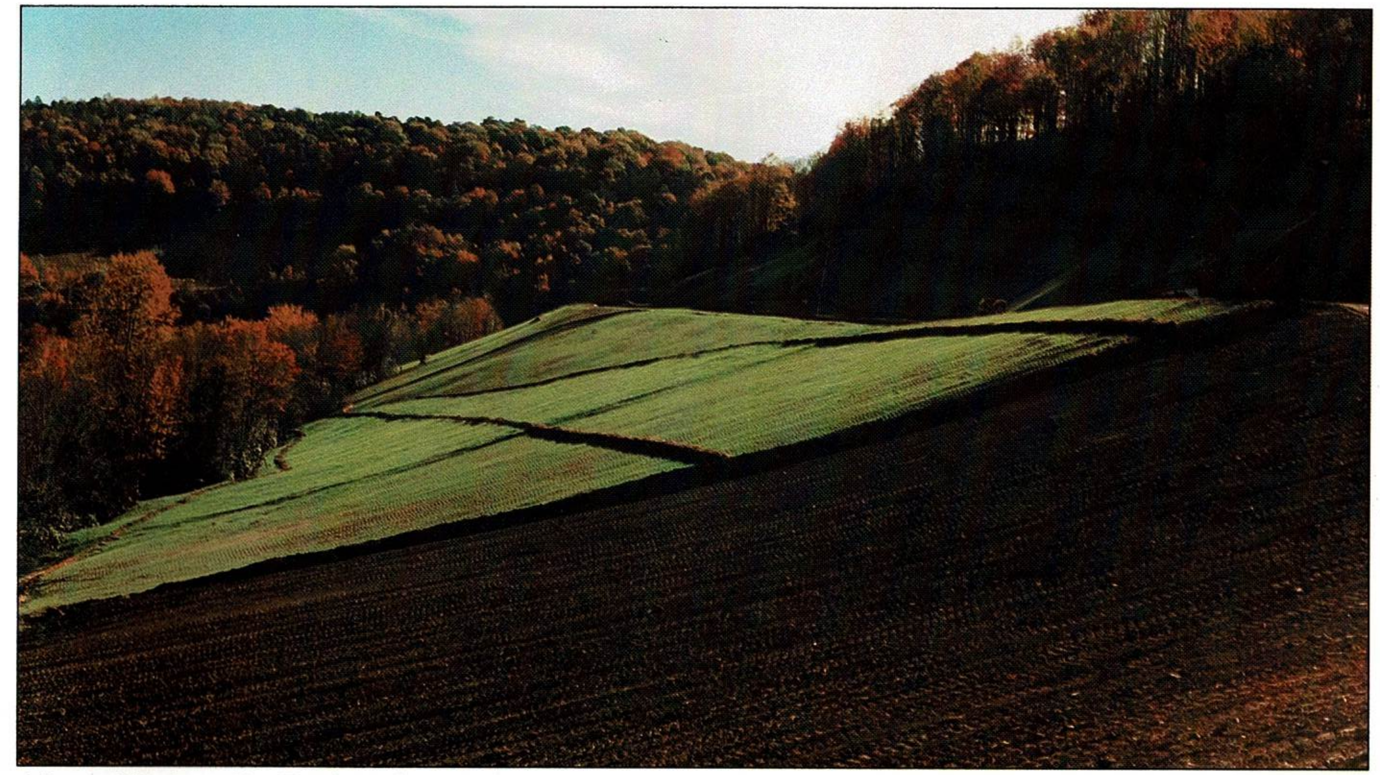

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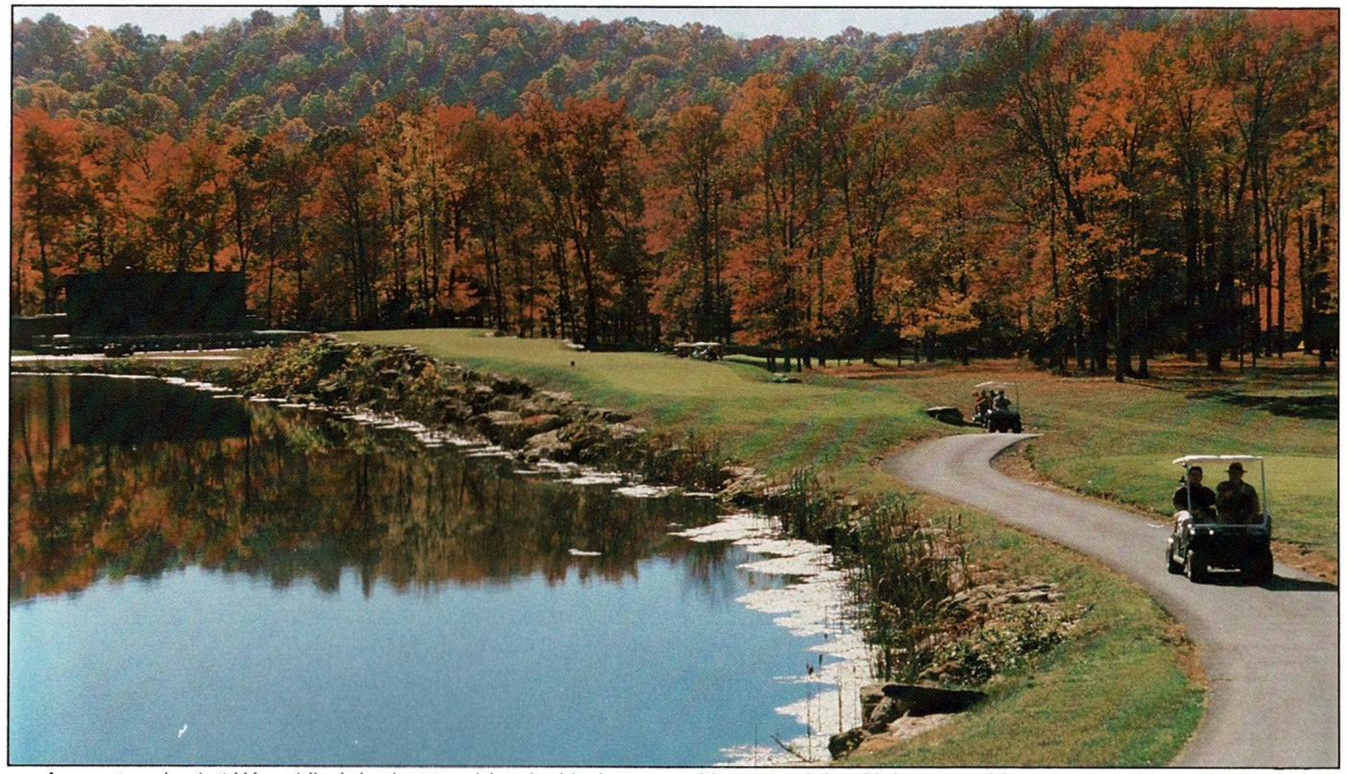
High Lift	19'-10" (6.04 m)	20'-0" (6.10 m)	23'-6" (7.16 m)



A spectacular fall West Virginia day combined with the natural beauty of the Club to provide a memorable outing.

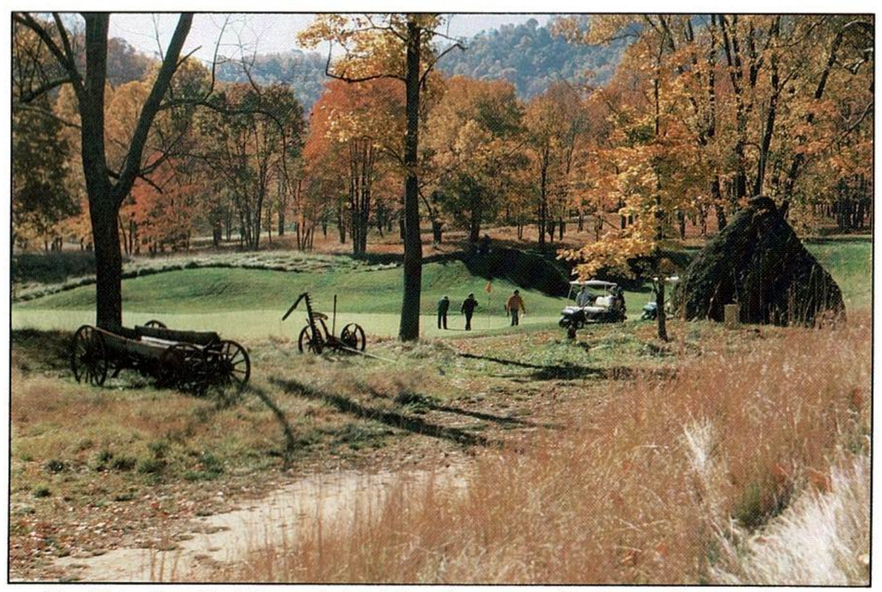
WVMRA Day at Pete Dye

Some 140 WVMRA members and guests were treated to a round on West Virginia's newest championship golf course in mid-October, as Jim Larosa ordered up a perfect fall day to show off his newly completed Pete Dye Golf Club, near Bridgeport.

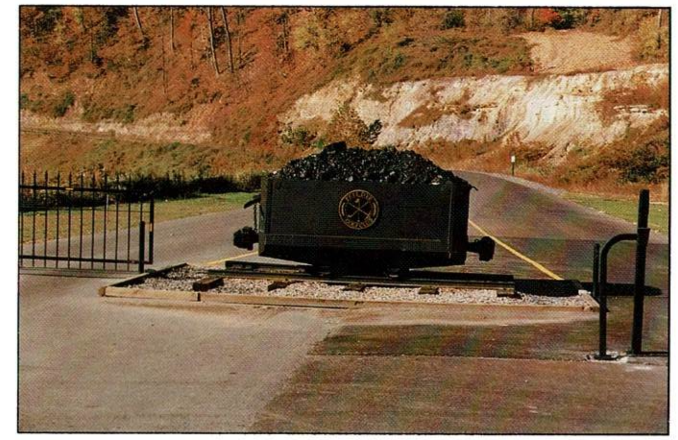
The Club, featured in the Summer, 1993 edition of **Green Lands**, is maturing nicely, with the opening of the back nine this fall securing its place among the finest golf courses in the region.

Designed by, and named for, famed golf architect Pete Dye, the course skillfully combines rustic West Virginia beauty with the natural heritage of the surrounding countryside.

Billed as a "national private club," Pete Dye has drawn visitors from Nevada, Florida, New York and many points between.

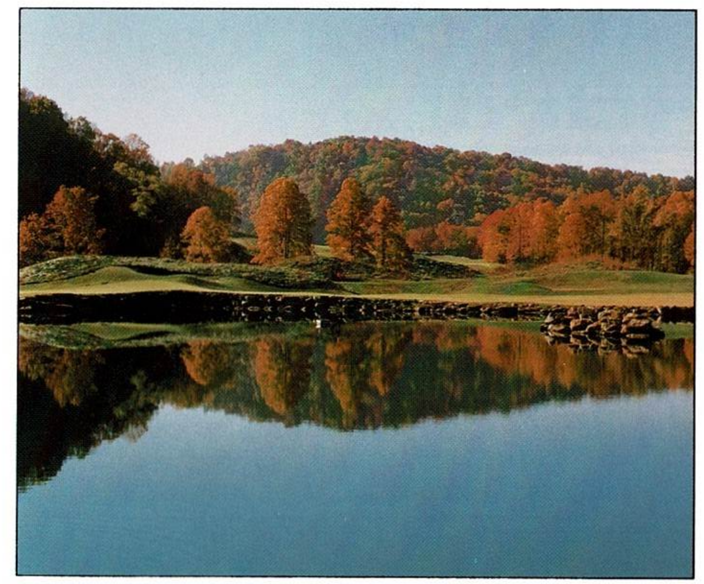


The Pete Dye Club has retained the character of its former incarnations as an Indian hunting ground, coal mine and farm land.



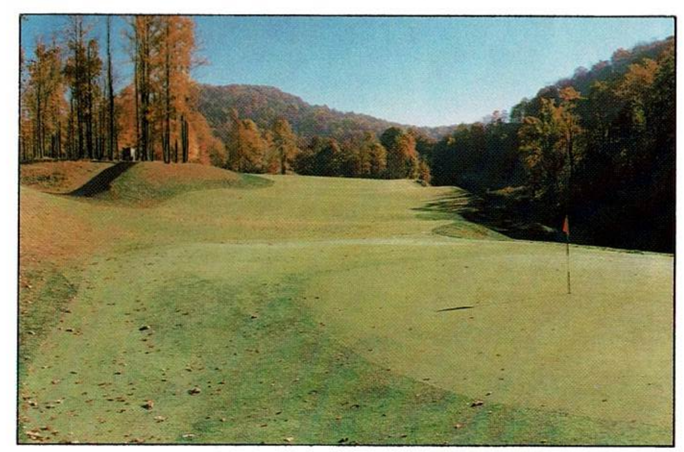
An impressive gateway reflecting the area's coal heritage now guards the entrance to the Pete Dye Golf Club.

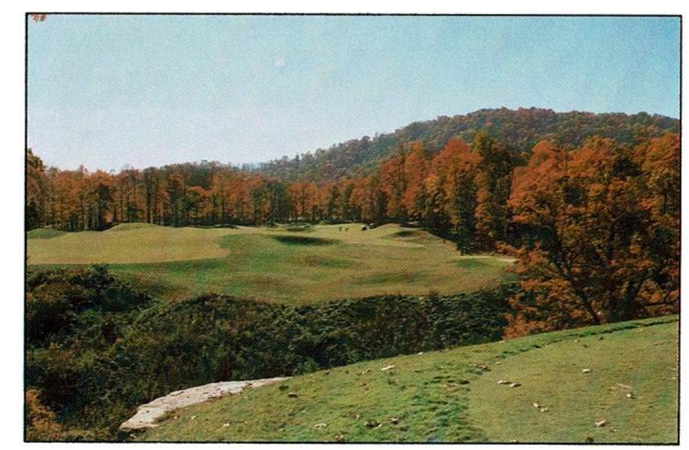
Members enjoyed the crisp outdoor setting as well as LaRosa hospitality on the Club's lunch deck.



Newcomers to the Pete Dye Golf Club were uniformly impressed with West Virginia's latest golf oasis.

Repeat visitors agreed that the Club grows more mature and beautiful with each visit.



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Douglas Abandoned Mine Land Project

Description of an Innovative Acid Mine Drainage Treatment System

by Jeff Skousen, West Virginia University

Introduction and History

"Coketon" is the term for the central mining facility of the Davis Coal & Coke Company between Thomas and Douglas, West Virginia. Located along the North Fork of the Blackwater River in Tucker County, Coketon was an integral part of the vast and productive industrial complex of Henry G. Davis. In 1884, the railroad reached Thomas where the Davis Coal & Coke had already begun active mining operations. Around the turn of the century, approximately 400 houses centered around the roundhouse and machine shops, and the valley was home to about 1,500 people. The community of Thomas boasted an opera house, hotels, banks, schools, and fraternal orders uniting 18 nationalities into the little city.

In the center of the Davis operation was a large coking facility on a mile and a half stretch of the North Fork between Thomas and Douglas. An 1887 experiment with two ovens convinced the coal company that a coking facility would be very profitable. The coal company converted raw coal into coke, the purest form of carbon and the most important by-product of coal. Coke was the premier "reducing agent" fuel in the world at the time, capable of smelting iron ore rapidly into steel through the Bessemer process. In the late 1800's, coke was produced by baking coal in huge stone or brick ovens until its impurities were driven off. The types of impurities driven out of the coal was a function of the amount of oxygen allowed into the oven (which was controlled by doors on the front of the oven) and the resultant temperature in the oven. It required nearly two tons of raw coal to produce one ton of coke. Long rows of "beehive" coke ovens, linked by tracks to the mine and tipple, burned night and day, tended by hundreds of laborers.

Eventually, Coketon contained 600 ovens. The Davis Coal & Coke Company's cokeyards employed about 150 men and burned for 250 days a year. By 1900, Coketon made Tucker County the third largest coke-producing county in the state. In 1904 alone, Coketon produced 200,000 tons of coke. During each year from 1915 to 1921, the fifteen mines near Coketon shipped over 1 million tons of coal, making it the sixth most productive operation in West Virginia.

In 1915, a change in mining technology revolutionized the steel making process thereby eliminating the need for coke ovens at the mine site. By 1919, there was no coke production whatsoever in Tucker County leaving the long banks of obsolete coke ovens unused. Coal, however, was still mined at the site in record quantities. From 1920 through the 1940's, the company continued production. As the seams were worked out and the mines closed, population slowly declined, and the facility slowly began to shut down. By 1950, only two mines, #36 and #40, were still working and tonnage had fallen to 100,000 by 1954. By 1956, underground mining had ceased altogether with a few surface mining operations producing coal through 1965.

Although time and vandalism have eroded the Coketon complex, significant ruins are nevertheless extant. The town of Thomas retains much of its architectural integrity, featuring the company store and office building, and numerous well-kept and relatively unaltered miners' houses. Poured and cut stone and masonry foundations remain from the power house, ventilation fan housing, and tipple support pillars. Railroad trestles and graded railbeds line the North Fork of the Blackwater. Several mine portals stand open, including the #29 portal. The Chief Inspector of the West Virginia Department of Mines observed in his 1904 Annual Report that "an unusual amount of water is generated at #29, and the drainage is not very good".

The most significant and striking cultural resources of the site are the rows of coke ovens which line both sides of the valley. An entire bank of ovens stands free in the middle of the site (Picture 1), while both walls of the hollow are lined with the brick and stone ovens. The roadbed of the Western Maryland Railroad extends some miles to Hendricks, and features fine cut stone bridges and gorgeous vistas of the canyon below. (The preceding information was excerpted from Stuart McGehee, 1992, "Coketon: Documentation of Historic Resources").

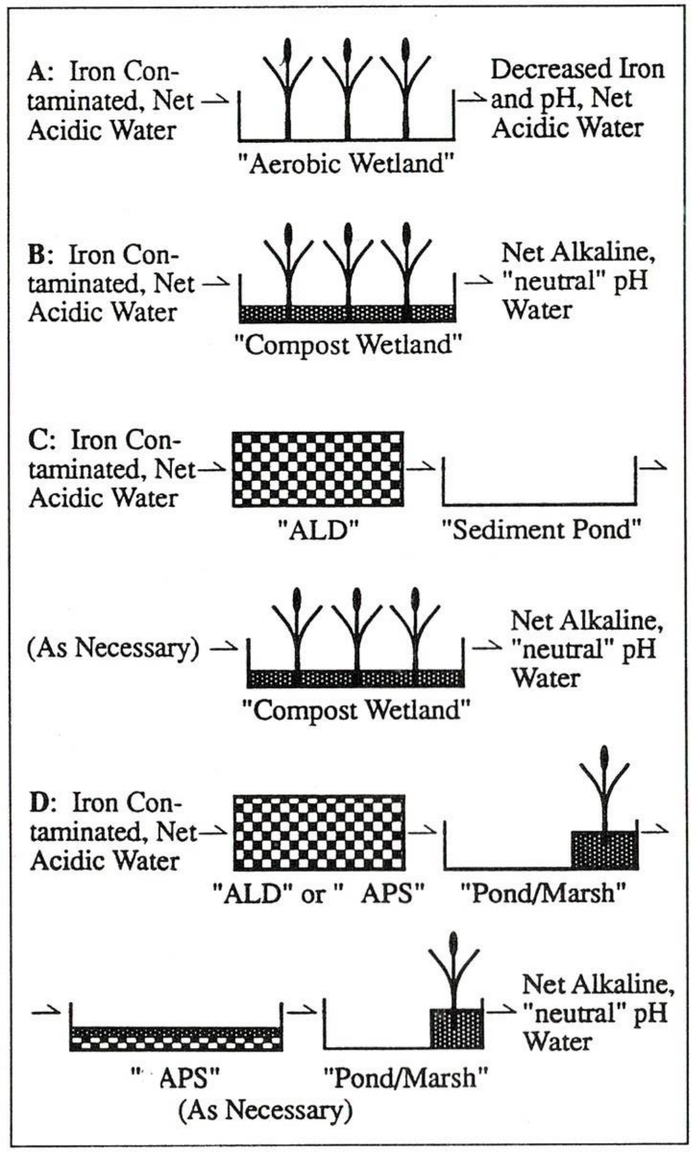


Figure 1. Evolution of passive AMD treatment technologies. Letter A represents the first generation of aerobic wetlands, while B shows an anaerobic-compost wetland. Anoxic limestone drains (ALD) were then designed to add alkalinity to the water before passage into an aerobic pond or wetland for metal precipitation and floc accumulation. If needed, then the water could be rerouted into a compost wetland (C). The next phase (D) involved the development of alkalinity-producing systems (APS) which combined ALD and anaerobic-compost wetland technologies. (Adapted from D. Kepler and E. McCleary, 1994, Successive alkalinity-producing systems (SAPS) for the treatment of acidic mine drainage. p. 195-204. In: International Land Reclamation and Mine Drainage Conference, U.S. Bureau of Mines SP 06A-94, Pittsburgh, PA).

Possible Treatment Systems for the Acid Mine Drainage

The #29 Mine Portal emits acid mine drainage from old deep mine workings of the Davis Coal & Coke underground operations. Depending on the season of the year, acid mine drainage flows out of the mine at the rate of 300 to 1,000 gpm. Analysis of the water has given the following range of water quality:

flow	200 - ???? gpm (3,000 max)
pH	2.8 - 3.7
Acidity	400 - 600 mg/l
Total Iron	25 - 40 mg/l
Ferric Iron	11 - 17 mg/l
Ferrous Iron	14 - 23 mg/l
Manganese	5 - 11 mg/l
Aluminum	30 - 55 mg/l
Sulfates	700 - 800 mg/l
Dissolved Oxygen	<1 - 4 mg/l

Treating this water at an average flow of 500 gpm and 500 mg/l acidity with any one of the conventional **AMD chemical treatment systems** would cost the following amounts per year:

Soda Ash	$176,500
Ammonia	$ 65,800
Caustic Soda	$200,100
Hydrated Lime	$ 61,300

Wetlands have been used to treat AMD because metals in acid mine drainage can be physically filtered by adsorption to organic materials, and the metals can also be oxidized/reduced by microbial reactions in the wetland and removed by precipitation. These processes remove metals from the water and neutralize some of the acidity (Figure1).

Anoxic Limestone Drains (ALD) are used to treat AMD that has low ferric iron concentrations (less than 5 mg/l), and also low dissolved oxygen levels (less than 1 mg/l). Due to the variable ferric iron concentrations and moderate oxygen levels, an ALD was unsuited to treat the drainage by itself.

Alkalinity-Producing Systems (APS) combine the use of an ALD and anaerobic compost wetlands. Under current APS designs, ponded water about 3 to 6 ft in depth overlies an 18-inch layer of compost which is over an 18- to 24-inch layer of limestone. Acid water is ponded over the materials and the head created by the column of water forces the water through the organic material to filter out or precipitate ferric iron and to consume oxygen through organic matter decomposition. Alkalinity may be generated through microbial sulfate reduction. The acid water, now low in dissolved oxygen and ferric iron after passing through the organic substrate, is then directed down into the layer of limestone under the organic matter or through pipes into a conventional ALD (Figures 1 and 2).

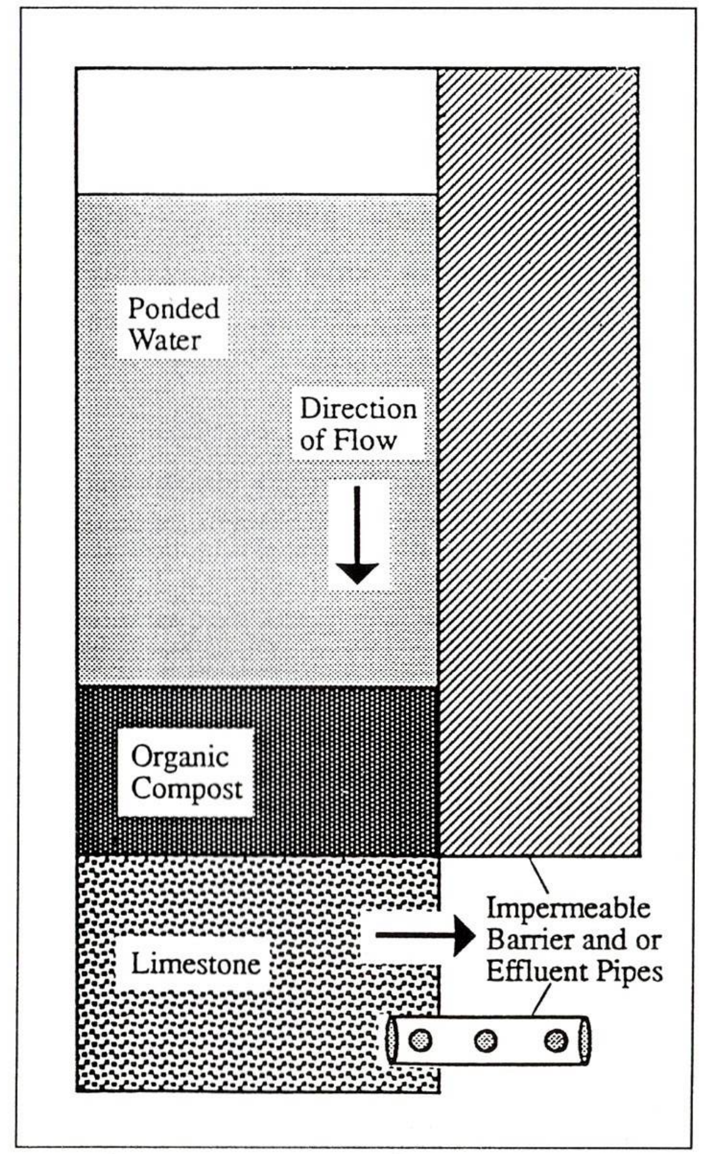


Figure 2. A cross-sectional view of an alkalinity-producing system (APS) for AMD treatment (Adapted from Kepler and McCleary, 1994).

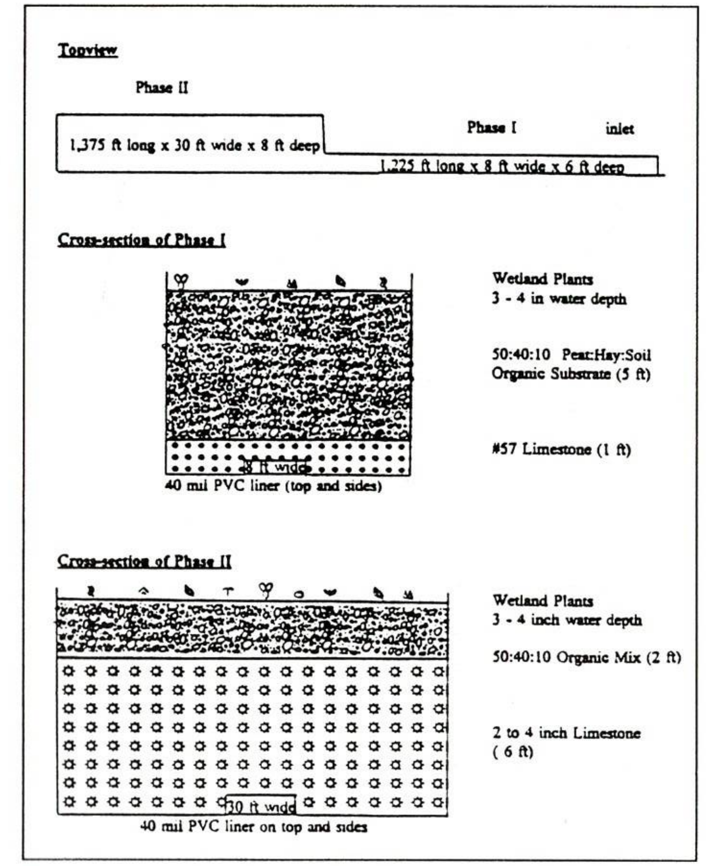
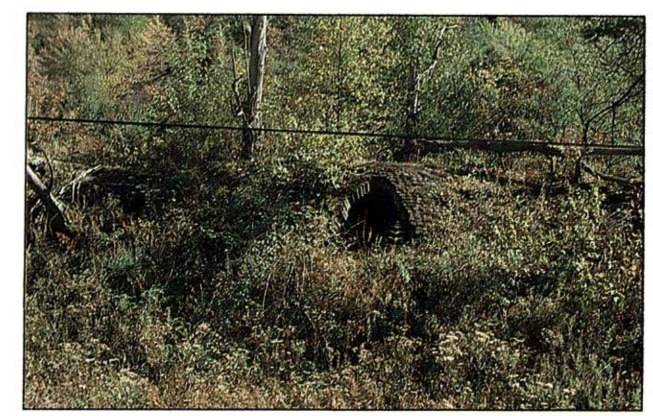


Figure 3. Construction specifications of the ALD/Wetland treatment system constructed on the Douglas Highwall AML Project. Topview shows overall dimensions, and cross-sectional views are given for the Phase I (8-ft wide) and Phase II (30-ft wide) sections.

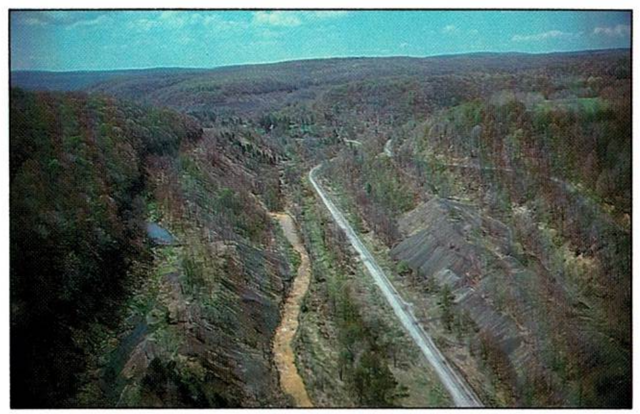


Picture 1. One of the 600 potential 2-ton coke ovens on the Douglas Highwall AML Project. Reclamation of the site left most of the ovens intact.

Picture 2. Approximately 18,500 tons of 2- to 4-inch limestone was placed in the Phase II section of the treatment system. The limestone was 6 feet in depth.

Picture 4. Thirteen sampling tubes were installed in the treatment system. Each tube contains 5 ports from which water and sediment samples can be extracted from 5 different depths in the system.

Picture 3. The limestone was overlain by filter fabric, and 2 feet of a mixture of peat, hay, and soil was placed on the surface.



Picture 5. Aerial photograph of the Douglas Highwall AML Project before construction. Highwalls and benches can be observed on the left along with a large refuse pile on the right. The North Fork of the Blackwater River is in the center paralleled by the railroad bed. This picture was taken on May 11, 1992 before construction occurred.

The Treatment System at the Douglas AML Site

During the planning and engineering phases of this AML project, the decision was made to treat this water with a combination of passive systems. The system designed at the Douglas Highwall project is different from the systems shown in the figures. The system has two phases and employs an aerobic/anaerobic wetland at the surface, underlain by varying amounts of limestone (Figure 3). This system is different than other APS designs because the amount and thickness of organic matter is much greater and near the surface so that wetland plants can be established in the organic substrate. Such a system with this design has not been constructed on an actual mine site. The system is designed to facilitate four processes:

1. Remove ferric iron in the water by: 1) adsorption to or precipitation in the organic substrate in the surface of the treatment system, and 2) microbial ferric iron reduction producing soluble ferrous iron in the anaerobic sediment,
2. Remove the dissolved oxygen in the water by consumption of the oxygen through organic matter decomposition,
3. Add alkalinity to the water by: 1) microbial sulfate reduction in the anaerobic zone of the organic material, and 2) limestone dissolution from the ALD, and
4. Precipitate metals in the catchment basin before the water is discharged into the North Fork of the Blackwater River.

Construction Specifications

The AMD treatment system was constructed by digging a large trench along the old railroad grade. The first phase of the trench is 1,225 feet long by 8 feet wide and 6 feet deep (1,225 x 8 x 6 = 58,800 cubic feet or 2,178 cubic yards). About 1 foot of gravel-sized limestone (#57) was placed on the bottom with 5 feet of organic material (a peat, hay, and soil mixture, 50:40:10) over the top. The Phase I trench was filled with about 750 tons of limestone and about 1,800 cubic yards of organic material.

The second phase of the trench is 1,375 feet long by 30 feet wide and 8 feet deep (1,375 x 30 x 8 = 330,000 cubic feet or 12,220 cubic yards). About 6 feet of 2- to 4-inch limestone was placed on the bottom with 2 feet of organic material over the top. This area was filled with about 18,500 tons of limestone and about 3,000 cubic yards of organic material (Pictures 2 and 3).

In total, 19,000 tons of limestone and 4,800 cubic yards of organic material were placed in this ALD/Wetland System.

Operation and Function

This AMD treatment system will function by introducing approximately 240 gpm of acidic water from the #29 Portal into the ALD/Wetland System. Much of the ferric iron in the water will precipitate or be adsorbed onto the organic material in the surface of the wetland. If ferric iron comes into contact with limestone, ferric hydroxide will form around the limestone and make it less reactive for neutralization. Another portion of the ferric iron may be reduced by microorganisms forming soluble ferrous iron. Ferrous iron does not form a coating on limestone at pH 7 or less. It is important that the ferric iron be removed or reduced in the water as it moves downward through the organic substrate. Another concern is the potential coating of limestone or plugging of limestone pores by aluminum hydroxides. Aluminum adsorption and/or precipitation should also occur in the organic matter substrate as the water pH reaches 5.0 or above. The small amounts of oxygen in the acid water should be scavenged by microorganisms decomposing the organic matter as the water moves through the organic substrate. With little or no ferric iron and little oxygen, the limestone in the ALD/Wetland System should dissolve and add alkalinity to the water.

At the end of the passive treatment system, a small aeration and metal precipitation pond was constructed to catch/trap the metals before the water is discharged into the North Fork of the Blackwater. The metal hydroxide sludge that accumulates in the pond will have to be periodically cleaned out of the pond.

Calculated Longevity

Based on 240 gpm and 500 mg/l acidity, the treatment longevity of this drain with its 19,000 tons of limestone (95% CCE and 75% dissolution) is estimated to be 50 years. Organic material has a finite capacity to adsorb metals, so the longevity based on the capacity of the organic material may be less than 50 years. Wetland plants have been transplanted into the wetland and these plants will deposit additional organic material annually through die-back. Little information exists on the longevity of organic substrates in AMD-treating wetlands.

Monitoring of Metal Removal and Water Quality Changes

Thirteen sampling stations were installed in the ALD/Wetland treatment system (Picture 4). Eight sampling tubes (labeled A through H) were placed about 150 ft apart in the 8-ft section. Tubes I through M were placed in the 30-ft section about 275 ft apart. West Virginia University researchers (Skousen, Sexstone, Garbutt, Sterner, and Cliff) will monitor water chemistry at different depths of the substrate and at different distances from the beginning of the system. They will also evaluate the chemical and biological reactions occurring in the system over time.

Calculations of Iron Inputs and Residence Time

Iron Inputs at 240 gpm and 30 mg/l iron.
30 mg/l x 3.78 l/gal = 113.4 mg/gal
113.4 mg/gal = .1134 g/gal
.1134 g/gal = .0002498 lbs/gal x 240 gpm
x 60 min/hr x 24 hr/day x 365 day/yr
31,500 lbs iron per yr or 86 lbs iron per day

Residence Time at 240 gpm
388,800 ft^3 x 35% porosity = 136,080 ft^3
x 7.49 gal/ft^3 = 1,019,239 gal
240 gpm = 345,600 gal/day
28.3 liters = ft^3 = 7.49 gal
1,019,239/345,600 = **2.95 days**

Picture 6. Aerial photograph from nearly the same point as picture 5. The highwalls were eliminated on the left and the refuse pile has been regraded on the right. The ALD/Wetland system is located on the right side of the road and continues around the corner at the top of the picture. This picture was taken in September 1993.

Table 1. Preliminary water quality data from the ALD/Wetland passive treatment system at the Douglas Highwall AML site in June, 1994. Relatively clean water from the North Fork of the Blackwater River was being introduced into the system. Thirteen sample tubes were installed in the system labeled A through M, and water sampling ports were placed a 1-ft intervals from 2 to 6 feet in depth in the tubes. For example, water data for the A 2 sampling port was extracted from the first sampling tube (100 feet from the front) at 2 feet in depth in the system.

Sample Site	pH	Acid	Alkalinity	Fe	Mn	Al	Ca
		mg/l					
Influent	7.0	9.4	12.5	0.2	0.4	0.3	204
Tube							
A 2	6.8	40.6	31.5	2.2	0.4	0.2	199
A 4	6.5	28.1	37.5	0.5	0.3	0.1	248
A 6	7.0	3.1	50.0	0.2	0.3	0.1	260
M 4	6.9	34.4	237.5	0.0	0.2	0.0	1210
M 6	7.0	21.9	212.5	0.0	0.1	0.0	1281

Land Reclamation Construction Highlights

The Douglas Highwall AML Project contained approximately 62 acres of steeply sloping mine spoil and refuse, and roughly 4,200 linear feet of highwall that was vertical from 35 to 55 feet in height (Picture 5). Open and collapsed mine entries were also within the project limits. Reclamation of the site included these specifics (Picture 6):

- elimination of 4,200 feet of highwall,
- excavation and handling of 360,000 cubic yards of material,
- 62 acres of land were backfilled and revegetated,
- 5,300 feet of V-shaped subdrain were constructed on the pavement of the surface mine bench at the base of the highwall and covered during backfilling,
- 555 linear feet of underdrain were installed in various locations throughout the job,
- 550 linear feet of riprap were placed for erosion control along the regraded slope along the river,
- 1,500 linear feet of trapezoidal-type, fabriform-lined ditch were installed to receive discharges from the subdrains prior to outletting into the river,
- 7,600 linear feet of silt control were placed on the project,
- 6 wet seals and/or modified seals were installed on open mine portals,
- the county road above the #29 mine entry was stabilized using 150 tons of stone and 53 cubic yards of grout.

Preliminary Results of the ALD/Wetland System

The treatment system was constructed in August 1993. It developed leaks and was unable to hold water. During December 1993, the contractor removed the organic matter and limestone, and installed a 40 mil PVC liner along the bottom and sides of the trench. The limestone was replaced in the lined trench, overlain by filter fabric, and the organic matter was returned to the trench. This process was completed by 15 December 1993.

During the spring of 1994, approximately 30 to 100 gpm of "clean" water (pH of 6.7, slightly net alkaline water, < 2 mg/l iron, < 1 mg/l manganese and aluminum) was pumped from the North Fork into the trench to fill the wetland and establish anaerobic conditions. Of the 65 total sampling ports available for sampling (13 sampling tubes at 5 depths), only 25 ports had sufficient water for extraction. Examples of water quality data for June before acid mine drainage was introduced are shown in Table 1. Alkalinity was 12.5 mg/l in the river water, and alkalinity rose to 212 mg/l coming out of the treatment system. Similarly, calcium increased from 200 to 1282 mg/l. The limestone is apparently dissolving. Acid mine drainage was introduced into the system on July 20, 1994. The first water sampling was conducted on August 15, 1994. Water quality data from the beginning (Tube A), middle (Tube E), and end (Tube M) at several depths are shown in Table 2. The pH of the portal water (influent) in August was 3.7, acidity was 394 mg/l, iron was about 25 mg/l, and aluminum was 30 mg/l.

At the first sampling tube (A) approximately 100 ft into the system, water extracted from the 2-foot port (A 2) showed a pH of 3.2, 300 mg/l acidity, and 12 mg/l iron. In the middle of the 8-ft section (sampling tube E located about 750 ft from the front of the system), pH was between 3.7 and 6.4 from the 2-ft to 6-ft ports, while acidity was decreased by half. Iron was less than 3 mg/l in all ports, and aluminum was slightly decreased.

In the last sampling tube (M located about 50 ft from the end of the system or 2500 feet from the front), water pH at all depths was greater than 7.0, the water showed a net alkalinity of about 100 mg/l, and very small amounts of iron, manganese, and aluminum were found in the water. Calcium increased from 500 mg/l at the influent to around 1,500 mg/l. The effluent water going over a notched weir at the end of the system was similar in quality to the water extracted in sampling tube M.

Water samples were also taken in September 1994 (Table 2). Influent pH was 2.9, acidity was 406 mg/l, while iron and aluminum were close to August concentrations. In sampling tube A, water pH at 2 ft was 3.0 and acidity was 269 mg/l. At 4 ft, the pH was 5.3 and net acidity was 20 mg/l. At sampling tube E, pH varied with depth from 3.6 to 5.3 and acidity was between 60 and 215 mg/l. Metal concentrations were 1 to 14 mg/l for iron, 5 mg/l for manganese, and 1 to 25 mg/l for aluminum.

At the end of the treatment system (sampling tube M), water pH was greater than 6.3, net alkalinity was greater than 200 mg/l, and little iron, manganese, and aluminum were found. Calcium concentrations were increased from 500 mg/l at the influent to 1,800 mg/l at sampling tube M. Effluent water quality was similar to that in sampling tube M.

Preliminary data shows that the system is effectively raising pH from around 3.0 to greater than 6.0. Acidity is being reduced from 400 mg/l to 0, and alkalinity is being increased from 0 to about 200 mg/l. All the iron, manganese, and aluminum is being filtered or precipitated in the ALD/Wetland system. Water samples will continue to be extracted quarterly.

Table 2. Water quality data from the ALD/Wetland passive treatment system at the Douglas Highwall AML site in August and September, 1994. Acid mine drainage was introduced into the system on July 20, 1994. Sampling sites are as described in Table 1. Tube A is 100 feet from the beginning, E is 750 feet from the beginning, and M is 50 feet from the end, or 2550 feet from the beginning.

Sample Site	pH	Acid	Alkalinity	Fe	Mn	Al	Ca
		mg/l					
August Sampling Date							
Influent	3.7	393.7	0	24.3	5.7	30.9	537
Tube							
A 2	3.2	300.0	0	12.6	7.5	32.0	691
A 4	5.5	106.3	37.5	21.9	6.5	8.1	1117
A 6							
E 2	3.7	143.7	0	2.3	2.7	14.9	606
E 4	3.7	237.5	0	1.5	5.5	23.7	866
E 6	6.4	31.3	31.5	0.1	3.4	0.4	1475
M 2	7.4	18.8	56.3	0.4	0.2	0.1	912
M 4	7.4	25.0	106.3	0.1	0.3	0.1	1595
M 6	7.4	18.5	118.8	0.1	0.2	0.0	1477
Effluent	7.3	18.8	75.0	0.3	0.1	0.3	1290
September Sampling Data							
Influent	2.9	406.3	0	20.1	6.4	33.1	522
Tube							
A 2	3.0	268.7	0	13.6	7.0	29.3	717
A 4	5.3	66.8	50.0	6.3	5.8	0.2	1592
A 6							
E 2	5.3	118.7	0	14.2	5.5	0.7	1411
E 4	3.6	212.5	0	3.5	5.0	25.0	806
E 6	4.4	62.5	6.3	1.3	5.5	4.3	1265
M 2	6.4	62.0	237.5	3.8	0.4	0.1	1800
M 4	6.6	18.6	237.5	0.2	0.1	0.1	1837
M 6	6.6	18.0	243.8	0.1	0.1	0.1	1806
Effluent	6.7	0	231.3	0.1	0.0	0.0	1974

Table 3. Average water flows and quality in the North Fork of the Blackwater River during various months from 1991 to 1994. Measurements were taken weekly and average values were calculated for flow, acid, and elemental concentrations. The range of water pH is also shown. The sampling site is located downstream from the Douglas Highwall AML Project. Acid load was calculated by flow (gpm) x acid (mg/l) x .000186 to give tons of acid per month.

Date	Flow	pH	Acid	Fe	Mn	Al	SO_4	Acid Load
	gpm				mg/l			Tons/month
Sep 91	10,100	3.5 - 3.5	99	12	3	—	275	186
Oct 91	5,310	3.3 - 3.3	186	11	4	—	324	184
Nov 91	5,050	3.3 - 3.4	139	11	3	—	374	130
Dec 91	16,190	3.4 - 3.5	77	9	1	—	76	232
Oct 92	3,236	2.3 - 3.5	142	10	5	14	316	85
Nov 92	6,667	3.7 - 4.4	58	9	1	5	55	72
Dec 92	15,610	3.5 - 3.7	66	5	1	6	48	192
Jan 93	15,410	3.2 - 3.7	83	7	1	7	86	238
Feb 93	10,250	3.1 - 3.8	97	7	2	9	140	185
Mar 93	24,280	3.2 - 4.0	67	4	1	6	347	303
Apr 93	26,140	2.9 - 3.4	104	7	1	6	104	506
May 93	5,625	2.1 - 3.2	136	6	2	10	134	142
Start of Construction								
Jun 93	2,737	3.0 - 3.3	95	6	2	9	195	48
Jul 93	1,570	2.8 - 4.3	153	10	3	15	357	45
Aug 93	890	3.0 - 3.2	172	11	3	16	340	28
Sep 93	950	3.1 - 3.9	126	11	3	17	227	22
Oct 93	2,425	3.5 - 4.1	73	8	2	9	140	33
Nov 93	20,680	3.5 - 3.6	55	6	1	7	66	212
Dec 93	17,430	3.2 - 3.9	71	8	2	9	106	230
Jan 94	16,090	3.3 - 3.8	88	6	1	6	139	263
Feb 94	28,620	2.9 - 3.6	164	11	2	9	211	873
Mar 94	27,300	3.0 - 3.7	96	6	1	7	137	487
Apr 94	20,510	3.5 - 3.9	87	5	1	7	142	332
May 94	18,940	3.3 - 4.2	78	5	2	6	141	275
Jun 94	8,390	3.3 - 4.4	89	6	2	9	195	139
Jul 94	7,940	3.3 - 4.4	77	5	2	8	117	114
Aug 94	21,340	3.5 - 4.6	56	4	1	5	71	222
Sep 94	5,860	3.1 - 4.0	116	7	4	7	244	126

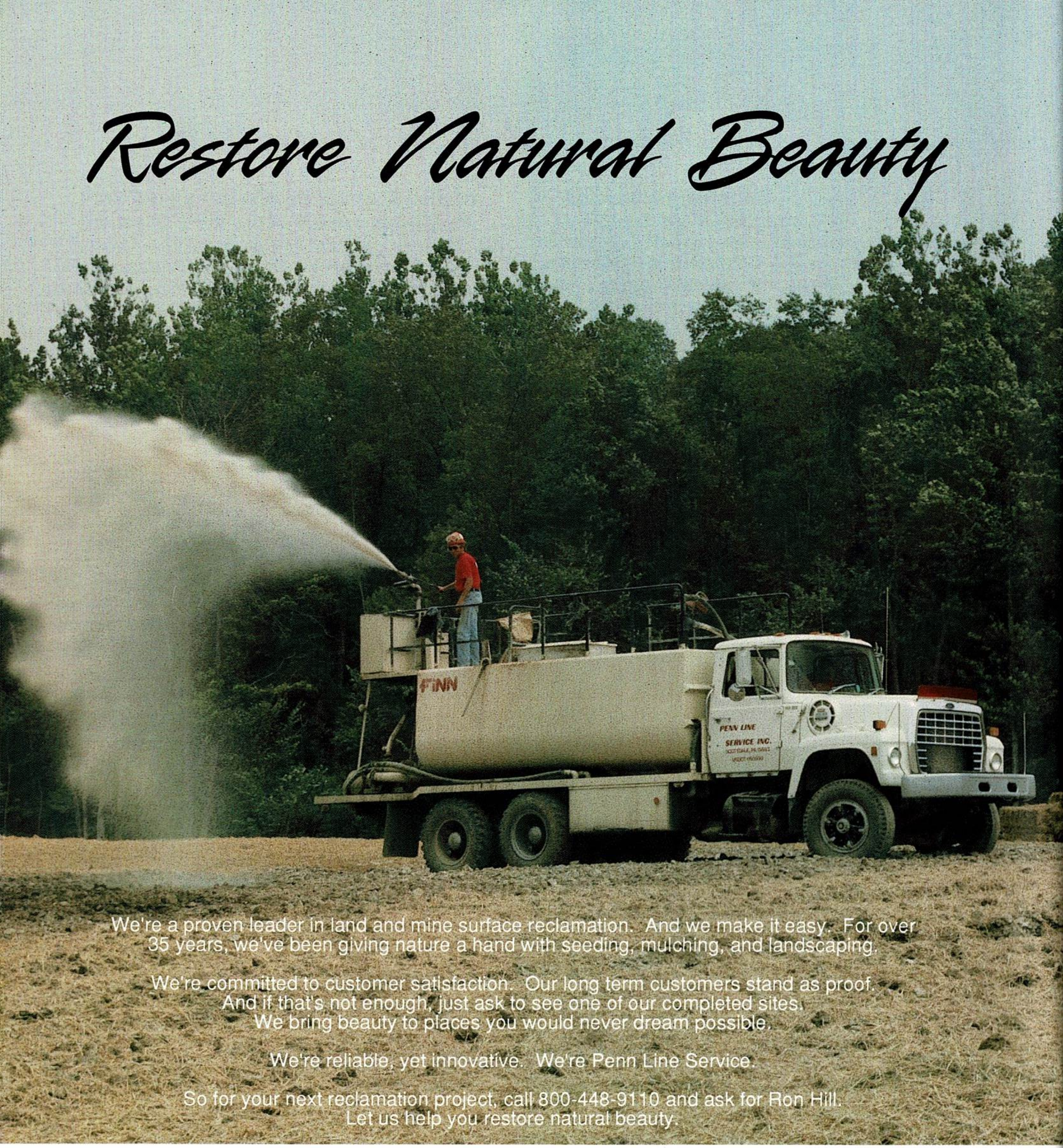
Preliminary Results on Water Quality in the North Fork of the Blackwater River

Flows have been measured at a gauging station and water samples have been extracted and analyzed for pH, acidity, and elements since 1991 (Table 3). The water was measured downstream of the Douglas Highwall Project. No clear trends are obvious at this early date after construction. However, average water flow during September through December, 1991 was 9,163 gpm and acid concentration was 125 mg/l. For the same period in 1993, average water flow was 10,371 gpm and acid concentration was 81.2 mg/l. The total acid load from September through December based on these data was 732 tons in 1991 and 497 tons in 1993.

From January to September 1993, flow averaged 9,761 gpm and acidity averaged 115 mg/l. During the same time in 1994, flow averaged 17,221 gpm and acidity was 94.5 mg/l. Construction at the Douglas Highwall Project began on June 1, 1993 and was completed October 21, 1994. The project has not gone through final inspection and the contractor has not yet been released from his obligations on the site.

Acknowledgements

Alan Sexstone and Keith Garbutt are co-investigators on this project. The author also acknowledges the extensive work of Pat Sterner and John Cliff in water collection and water analysis. Special thanks go to the West Virginia Division of Environmental Protection and to Triad Engineering, Inc. for initiating West Virginia University's involvement in the project. Special appreciation is extended to Director David Callaghan, Dave Broschart, and David L. Smith. Breckenridge Corporation was the contractor on the site and thanks go to Alan Shreve and Tim Stump for allowing WVU employees to be on site at various times during construction. Acknowledgement is given to Triad Engineering and Sheila Vukovich (WVDEP) for the River water data in Table 3, and to Buffalo Coal Company for aerial photographs. Funding for conducting the research on this project comes from the U.S. Bureau of Mines and the National Mine Land Reclamation Center.



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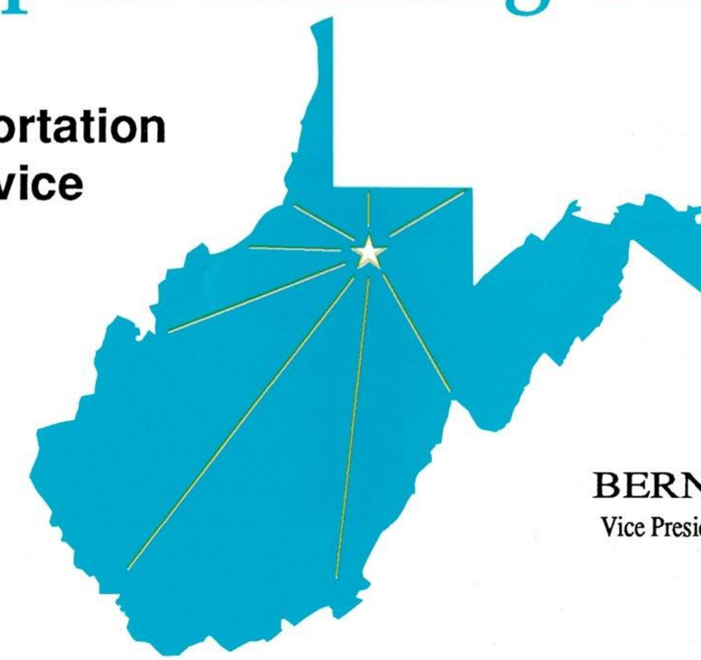

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Vice President and General Manager

33 Walnut St.
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(304) 592-1052
FAX 592-1054

Helen Curry (second from left) and her Burch Junior High coal students on the future airport site in Mingo County.

Coal in the real classroom

During each the last several years, WVMRA, the West Virginia Coal Association and the Peters Creek Coal Association have sponsored a four day "teach the teachers" program each summer. "Coal in the Classroom" is designed to expose public school educators to the many positive aspects of the coal industry.

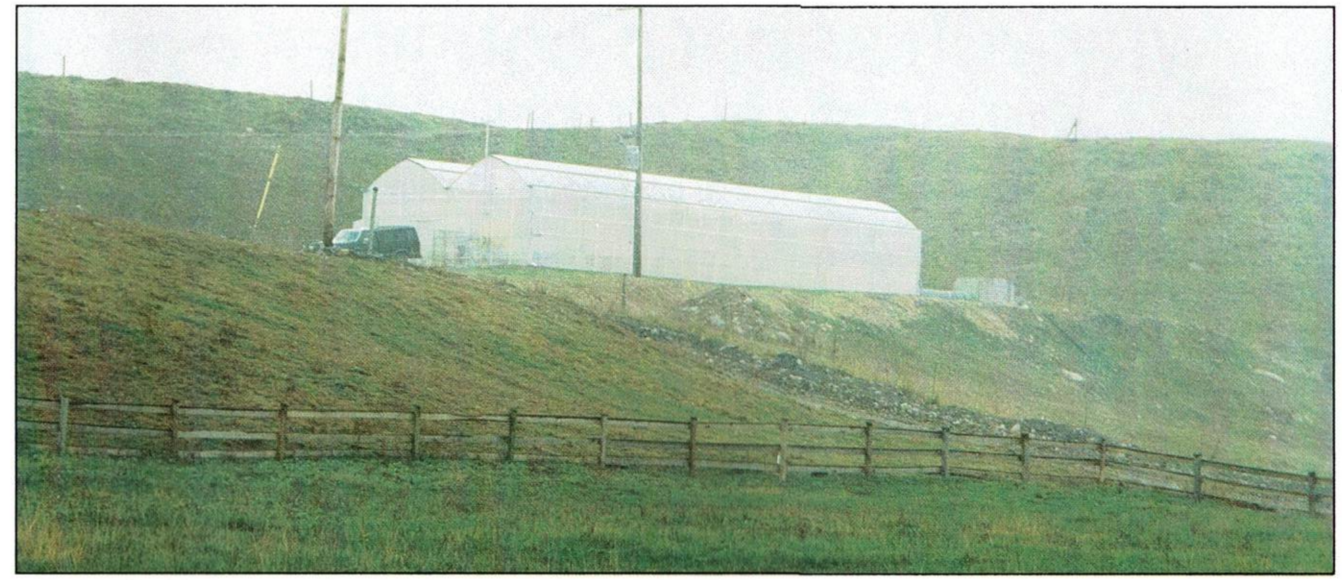
There were nineteen participants in the 1994 program, held at the MSHA Academy in Beckley. The group visited Eastern Associated Coal's Harris complex in Boone County, going underground in the Lightfoot No. 1 Mine and touring the Rocklick Preparation Plant. They also saw first hand the state's largest dragline at Catenary Coal's Samples Surface Mine in Kanawha County. Complementing the mine visits were tours of APCO's Glen Lynn electric generating facility and Fairchild International's equipment manufacturing plant.

But this year's program had a different and special result. One teacher returned home with the idea of really spreading the word about coal in West Virginia. Helen Curry, a teacher at Burch Junior High School in Mingo County, shared her experiences and her excitement about coal with Burch principal Tom Slone. Helen's idea was to teach coal in her classroom to one group of students for 45 minutes each day for an entire six-week period.

If that effort proved successful, Ms. Curry and Mr. Slone planned to assemble a second, third and forth group for subsequent classes. Mr. Slone demonstrated great open mindedness and flexibility by authorizing Ms. Curry to put together her unique lesson plan for this detailed examination of coal.

Burch Junior High is the first school in West Virginia where the young people have been provided an extended opportunity to learn specific details about the state's most important industry. Ms. Curry has completed the first six-week program and is in the middle of training her second group of students. All together, approximately 100 junior high students will be benefiting from this program during the current school year.

The actual lesson plan for the students includes review of coal publications, video tapes, hands-on classroom exercises, lectures from coal industry speakers, and at least one onsite visit to a coal mine or coal related facility. The initial class visited the nearby Cumberland River Mining complex at Ragland, in Mingo County. The visit included a surface tour of the preparation plant and contract underground and surface mining operations.



James Simpkins' greenhouse on his Mingo County mine site.

The students were surprised to learn that one of the mining contractors, James Simpkins, has incorporated some long range thinking into his post mining plan. Simpkins has prepared his mountain top removal surface mining site for possible development into a commercial airport with potential of having a huge, 8500 foot runway.

Simpkins has also been working with scientists from West Virginia University in an effort to produce a special root enhancing fungus. If this project meets the expectations of Simpkins, business partner Walden Hatfield and others who share in this effort, this fungus will be grown in greenhouses on the reclaimed surface mine and shipped by air directly to purchasers throughout the country.

Post mining use of surface mine sites in southern West Virginia may be a key to future economic development in these areas were flat land is at a premium. This pilot project in Mingo County is an excellent example of one of the lasting benefits of surface mining in West Virginia.

Helen Curry's students, many of whom are from coal mining families living close to Cumberland River Mining, got an opportunity to personally see the mining process and the postmining use of land, all in one visit.

Ms. Curry will continue to fine tune her innovative lesson plans with each of the four groups, making the final product valuable to other educators. Her experiences in developing this first extended "Coal in the Classroom" program will surely be shared with the teachers who get an opportunity to participate in the 1995 and later "Coal in the Classroom" programs.

In addition to Cumberland River Mining, other area mining operations have volunteered to assist Ms. Curry by providing visiting speakers and by hosting mine tours. Those operations include Northland Resources, Hampden Coal and A.T. Massey Coal.

James Simpkins explains the fungus growing process.

COAL CALENDAR

January

25-28 **6th Annual Mountain State Coal Classic,** Raleigh County Armory, Beckley, WV, contact Jim Justice, P.O. Box 1085, Beckley, WV 25802, (304) 252-8528.

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.

3-8 **Contractors Association of West Virginia, Mid-Year Meeting,** Aruba Hyatt Resort & Casino, Aruba, contact CAWV, 2114, Kanwha Blvd E., Charleston, WV 25311, (304) 342-1166.

March

22-24 **West Virginia Technology Design Exposition 95,** Charleston Civic Center, Charleston, WV, contact Pat Parsons, Expo -95, 2114 Kanawha Blvd. E., Charleston, WV 25311, (304) 342-3976, FAX 342-1074.

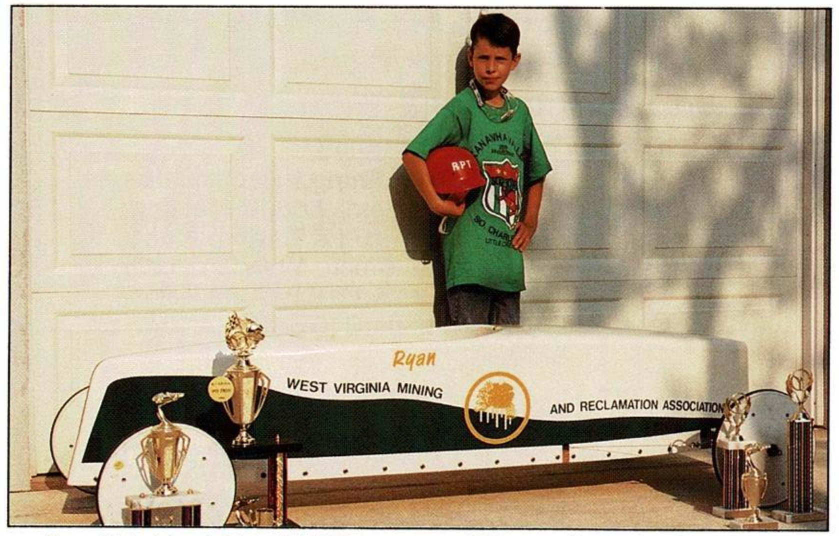
April

11-12 **2nd Annual Mine Health & Safety Workshop,** Washington, D.C., contact Fred Shear, Pasha Publications, 1616 North Fort Myer Dr., Suite 1000, Arlington, VA 22209, 1-800-424-2908 or (703) 528-1244, FAX 528-1253.

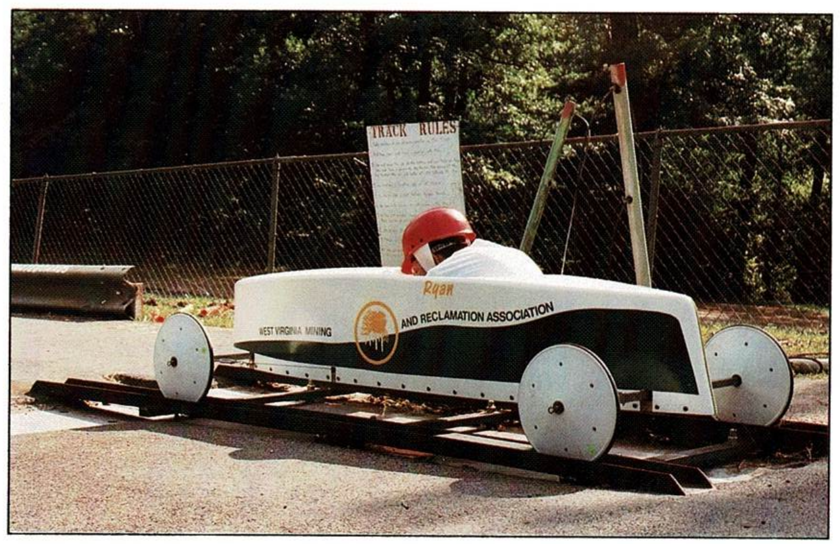
Association Notebook

WVMRA a winner in Soap Box Derby

The Association's colors are flying high in Charleston area soap box Derby competition. Sponsored by WVMRA, 9 year old Ryan Trimble, races a sleek looking gravity powered vehicle decked out in Association green and gold, sporting our distinctive logo on each side.



Ryan Trimble with his WVMRA racer and his growing collection of trophies.



Ready to roll at Little Creek Park.

In his first season of "All American" racing, Ryan represented the Association well, finishing just short of the winner's circle in local competion at Little Creek Park in South Charleston.

At the start of the fall season, Ryan took first place in a field of 24 racers, putting himself in position for a strong run a the 1995 field, which culminates in a trip to Akron, OH for the world championships.

Ryan's proud father is Mark Trimble of Vibra-Tech Engineers, Inc. Mark reports that the WVMRA logo has attracted quite a bit of attention. "Ryan's car is always one of the best looking racers on the track. It's amazing how many people recognize the logo. Those who don't are interested in learning what it stands for."

New members

Five companies were approved for membership during the Board of Directors' Meetingin October, two in the General Division and three in the Associate Division. In addition, we are pleased to announce the reinstatement of charter member **Grafton Coal Co.** of Bridgeport, with Jerry Righman as the representative.

Welcome to the following new members and their representatives:

GENERAL DIVISION - Acme Limestone Co., Fort Spring, WV representative - Tony DiRico; **Three-C Mining, Inc.,** Volga, WV, representative - Carl Carbonara.

ASSOCIATE DIVISION - Civil & Environmental Consultants, Inc., Cincinnati, OH, representative - Robert Kalchthaler; **Richard M. Lewis Co.**, Charleston, WV, representative - Dick Lewis; **TERRADON Corp.,** Nitro, WV, representative - Dana Burns.

Association Notebook

The Conrail Express, reminisent of old time luxury railroad dining cars, makes ready for departure from the Dickinson Yards at Quincy.

Peters Creek Coal Association rides Conrail Express into the mountains

The Peters Creek Coal Association traditionally convenes twice a year, once for golf, and once for a movable feast.

Peters Creekers used to board the riverboat West Virginia Belle for a Kanawha River dinner cruise, but the Belle was sold out of the area, and so PCCA turned to the railroad for eat-on transportation.

For this year's fall outing, the "Conrail Express" was pressed into action, transporting two trainloads of passengers from Conrail's Dickinson Yards at Quincy on a round trip to the High Power Mountain mining operation in Nicholas County.

A sumptuous meal was served in route, and the day was capped by the traditional dinner at Edgewood Country Club in Charleston, where PCCA officials distributed a dazzling array of door prizes to an overflow crowd.

The Peters Creek Coal Association is a nonprofit organization composed of members engaged in the mining, transportation and sale of coal and related activities. The events are open only to PCCA members. For membership information, contact Mike Perilli at (304) 872-4586.