U. S. FOREST SERVICE RESEARCH NOTE NE-52

1966

N

FOREST SERVICE, U. S. DEPT. OF AGRICULTURE, 6816 MARKET STREET, UPPER DARBY, PA.

E

LAND DISTURBANCES FROM STRIP-MINING IN EASTERN KENTUCKY
1. UPPER CUMBERLAND COAL RESERVE DISTRICT

Open-pit or strip-mining—primarily for coal—has expanded rapidly in eastern Kentucky during the past 15 years. Information about the amount, location, and general characteristics of the disturbed areas is necessary for appraising the economic impacts and overall effects of strip-mining in that section of the state, for planning reclamation programs, and for determining research needs and priorities. To obtain reliable estimates of the acreage disturbed both by the mining itself and by the associated coal-haul roads, and to provide relevant information about the disturbed areas, a survey was made. The survey was based on aerial photographs of all stripped areas as of October 1964.

The survey was broken down in accordance with the six subdivisions or coal-reserve districts delineated by the U. S. Geological Survey.[1] Thus there will be a series of six reports, of which this is the first.

The method used in our survey was a modification of forest-survey procedure. A 3-by-6-inch transparent template with 25 dots per square inch was positioned over the center of each photograph. Areas on the photographs that appeared to be stripped land or coal-haul roads were examined stereoscopically to determine important characteristics, and the amount of area in various categories was estimated by dot counts.

[1]Huddle, J. W., F. J. Lyons, H. L. Smith, and J. C. Ferm. COAL RESERVES OF EASTERN KENTUCKY. U. S. Geol. Survey Bull. 1120, 147 pp., 1963.

The Upper Cumberland District

The Upper Cumberland Coal Reserve District lies in southeastern Kentucky between Pine Mountain on the northwest and the state boundary (with Virginia and Tennessee) on the southeast (fig. 1). It includes 83 percent of Harlan County, 60 percent of Bell County, 15 percent of Letcher County, and 3 percent of Whitley County.

Commercial coal production began in Bell County in 1879 and in Harlan County in 1911. Until the early 1950's, all production was from underground mines. But by 1963 about 15 percent of the coal came from strip- and auger-mining.[2] However, the percentage varies by county. For example, 50 percent of the coal mined in Bell County in 1963 came from strip- and auger-mining, while only 6 percent from Harlan County was mined this way.

District coal reserves (measured, indicated, and inferred) are estimated to be 3.7 billion tons. Thirty-eight percent of this is in seams more than 42 inches thick. There are no estimates of the tonnage that can be recovered exclusively by strip- and auger-mining.

[2]Mandt, A. H. ANNUAL REPORT. Ky. Dep. Mines and Minerals. 166 pp., 1963.

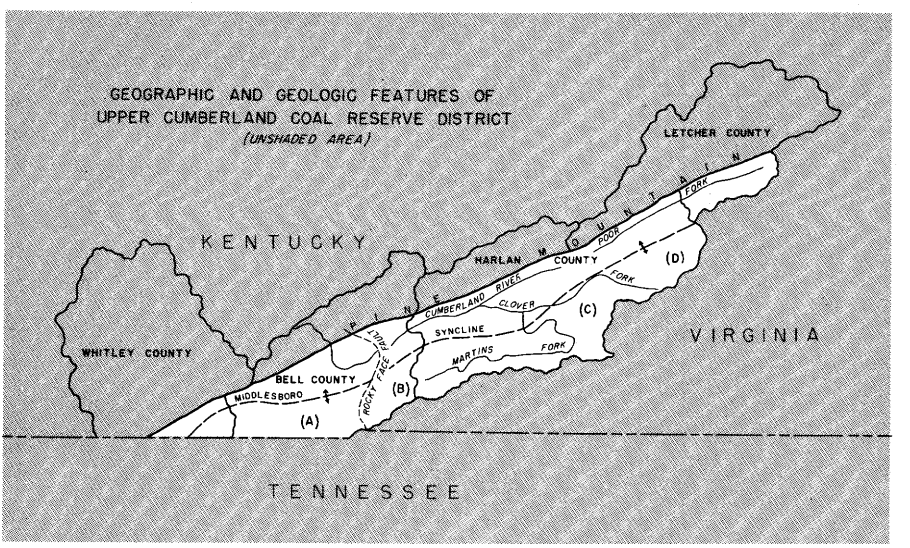


Figure 1.—Geographic and geologic features of the Upper Cumberland Coal Reserve District. The letters (A), (B), (C), and (D) indicate the location of the main stratigraphic columns: Log Mountain, Hance Ridge, Little Black Mountain, and Big Black Mountain, respectively.

Forest Cover

The 1964 Kentucky forest inventory showed that forests cover about 85 percent of the Upper Cumberland Reserve District. Non-forest lands used for agriculture, roads, and urban development are concentrated generally on the lower slopes and valley bottoms. This land-use pattern is also reflected in our survey of lands disturbed by strip-mining. Eighty-five percent of the strip mines were located on the upper slopes and ridges; forested land was immediately below and adjoining 99 percent of the disturbed areas.

Nearly all of the forests have been cut over, but the forest inventory classified 85 percent of the commercial forest stands as sawtimber size. These are predominantly hardwoods, with species of oak and hickory in great abundance. Yellow-poplar, maple, beech, basswood, black walnut, and elm occur frequently in the stands on better sites. Southern pines are not well represented in the district: less than 5 percent of the commercial forests are classified as pine or pine-hardwood types.

Physiography and Geology

The District is characterized by high, narrow ridges, V-shaped valleys, and steep slopes. The Black Mountains east of Harlan are the highest land in the District, rising at one point to an elevation 4,150 feet above sea level—the highest point in the state. Pineville Gap on the Cumberland River, at 1,000 feet, is the lowest spot in the District.

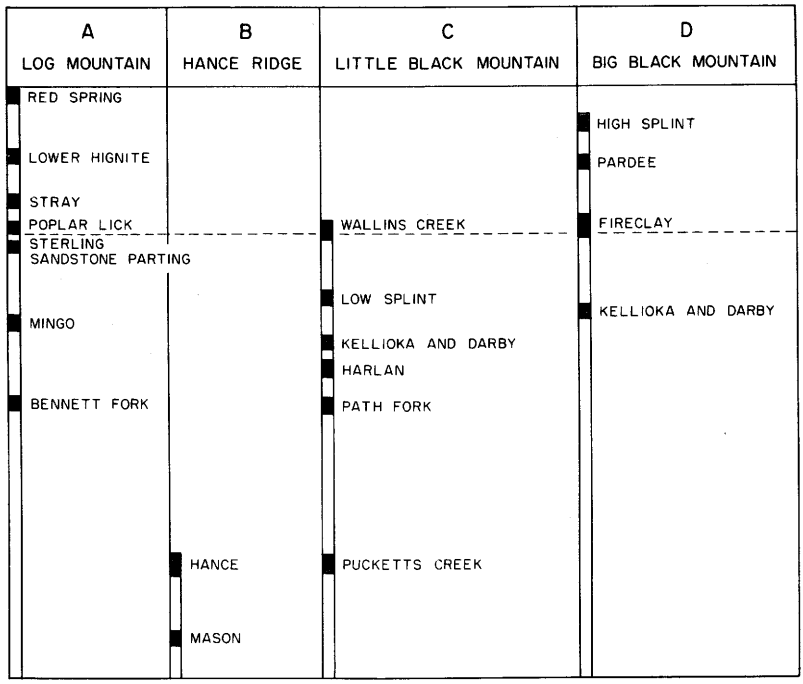
The predominant geologic feature is the Cumberland overthrust block.[3] The leading edge of this block folded and warped upward to form a high, 150-mile-long ridge now known as Pine Mountain.

Another prominent feature, the Middlesboro syncline, runs the length of the district parallel to the southern slope of Pine Mountain. This structure controls the elevation of all rock strata and coal seams, and determines the location and extent of reserves recoverable by strip mining. For example, a given coal seam outcropping on a mountain slope near the Kentucky-Virginia state line may be recovered by open-pit mining; but the same seam further north near the Cumberland River could not be recovered by surface-mining equipment because of its downward dip.

A third feature is the Rocky Face fault—a faulted arch—which formed Cumberland Gap, Rocky Face, and Pineville Gap. Because of this violent shift in the earth's crust, the coal seams in the Log Mountains west of

[3]McFarlan, A. C. GEOLOGY OF KENTUCKY. Univ. Ky. 531 pp., 1950.

Figure 2.—Stratigraphic position of the principal coal seams mined by surface methods in the Upper Cumberland Coal Reserve District. The elevation of each seam above sea level could not be indicated precisely because of the varying thickness, dip, warp, and tilt of the underlying strata. The Poplar Lick, Wallins Creek, and Fireclay beds are correlated; and they serve as the marker bed for this district.



the fault and those at the same elevation east of the fault are different, as is obvious from differences in the overlying strata. Geologists consequently have difficulty in correlating seams across the fault.

The U. S. Geological Survey recognizes two formations within the District.[1] Their locations are correlated with the formative geology.

The Lee formation, which covers 30 percent of the 434,000 acres in the District, outcrops on Pine Mountain, the Virginia state line, and Rocky Face fault. This formation contains no commercial coal deposits.

The Breathitt formation, which occupies the remainder of the District area, is some 2,500 feet thick and contains 25 commercially important coal seams. Of these, 21 seams have been strip-mined or auger-mined to some degree. The correlation of the principal surface-mined coal seams is shown by stratigraphic position in figure 2. The nomenclature is according to usage accepted by most geologists.

Distribution of Stripped Areas

The area disturbed by strip- and auger-mining in the District in 1964 (excluding coal-haul roads) was 11,845 acres, or 2.7 percent of the total land area. Bell County had the largest acreage and the highest percentage of area disturbed (6,090 acres, 4.3 percent). Harlan County had more than 4,700 acres disturbed, but this was only 1.9 percent of its total area (table 1).

Table 1.—*Disturbed area by counties and coal seams in the Upper Cumberland Reserve District, in acres*

Coal seam	Whitley County	Bell County	Harlan County	Letcher County	Total
Harlan	—	718	1,536	—	2,254
Kellioka-Darby	—	852	902	308	2,062
Path Fork	—	1,765	76	—	1,841
Mingo	486	499	—	—	985
Poplar Lick or Fireclay	—	103	653	83	839
High Splint	—	—	742	83	825
Pardee	—	—	808	9	817
Stray	—	590	—	—	590
Pucketts Creek	—	530	—	—	530
Lower Hignite	—	384	—	—	384
Red Spring	—	311	—	—	311
Sandstone Parting	9	177	—	—	186
Mason	—	116	—	—	116
Bennetts Fork	51	45	—	—	96
Low Splint	—	—	9	—	9
All seams	546	6,090	4,726	483	11,845
Percent of land area disturbed	6.2	4.3	1.9	1.5	2.7

Among coal seams, the Harlan seam, outcropping only in Bell and Harlan Counties, was most extensively mined. Next in acres mined were the Kellioka and Darby seams, lumped together here because they are separated vertically by only 20 to 40 feet and could not be differentiated on aerial photographs. These two seams were worked in Bell, Harlan, and Letcher Counties. The Path Fork seam, mined only in Bell County, ranked third in disturbed area. These four seams account for 52 percent of the acreage disturbed by stripping. Table 1 gives additional details on distribution of the disturbed acreage, by counties and coal seams.

Physical Characteristics of Disturbed Areas

There are two basic types of strip-mining in the eastern Kentucky coal field: contour- or rim-stripping, and area-stripping. Auger-mining usually is employed as a supplement to contour-stripping; it is a means for working a seam beyond the point where removal of the overburden is economically feasible. Of the 434,000 acres comprising the District, 11,845 acres, or 2.7 percent, had been disturbed by strip- and auger-mining as of October 1964.

About 96 percent of all mining disturbance in the District had resulted from contour-stripping on mountain slopes. Contour-stripping employs small shovels of 1- to 6-cubic-yard capacity and bulldozers to expose the coal seams along narrow benches on steep mountain slopes. The benches are generally 100 to 200 feet wide.

In the contour-strippings, 10 percent of the disturbed area was on or above the highwall; 31 percent in pits, inslopes, and leveled or unleveled benches; and 59 percent in outslopes. Of the 6,700 acres of outslope, 800 acres, or 12 percent, were in slides or slumps.

On about 60 percent of the contour-stripping operations, there had been some grading of the spoil between outslope and highwall or pit. On about 25 percent of them, grading to nearly level benches had been done. Probably most of this leveling had been done since the enactment in 1954 of state legislation requiring grading and revegetation of areas disturbed by open-pit mining.

Area-stripping, which made up only 4 percent of the total area disturbed, was done typically where the land surface was less steep and the overburden was relatively shallow over a fairly wide area. Under these conditions, several successive parallel cuts were made. The same type of equipment was used as for contour-stripping. Our survey showed 477 acres in area-stripping, of which 47 acres were on lower mountain slopes and 430 acres were on ridge tops. In the latter locations, the entire top of the ridge or mountain usually was worked over. The breakdown among positions in the area strippings was as follows: leveled or unleveled spoil between pit and outslope—55 percent; outslopes—35 percent; and pits and highwalls—10 percent. No slides or slumps were found in the area-strippings.

In all stripping operations, the operator must build and maintain a network of roads for hauling the coal from the mines. In this survey, we classified the haul-roads as: primary (running from a public road to the mine); secondary (joining two pits or serving as spurs from primary roads); or third-class (service roads and temporary haul-roads).

We found 1,099 acres to be disturbed by coal-haul roads. This figure was computed directly from dot counts on the aerial photographs. After determining the average width of the road rights-of-way by field measurement, which came out as 76 feet, we converted acres to miles of road. By this calculation, there were 121 miles of coal-haul road in the District. This mileage was distributed among the three classes of roads as follows: primary, 87 miles; secondary, 22 miles; and third-class, 12 miles (table 2). Nearly all of these roads ran through forested country.

Table 2.—*Mileage of coal-haul roads in the Upper Cumberland Coal Reserve District, by classes and counties*

Class of haul road	Whitley County	Bell County	Harlan County	Letcher County	Total
Primary	1.1	32.0	50.8	3.4	87.3
Secondary	.8	9.0	11.8	.2	21.8
Third-class	.3	1.7	9.8	.0	11.8
All classes	2.2	42.7	72.4	3.6	120.9

From the totals in tables 1 and 2, we can calculate acres of mine disturbance per mile of road. Thus the District average is found to be 98 acres per road mile. The figure for Bell County is 143 acres per mile, and for Harlan County 65 acres per mile. The comparatively low acreage figure for Harlan County probably reflects the much more rugged topography of Harlan County as compared with Bell County.

—WILLIAM T. PLASS
Plant Ecologist
Northeastern Forest Experiment Station
Forest Service, U. S. Dept. of Agriculture
Berea, Kentucky