U.S. Department of the Interior
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Chapter I

Summary Report on the Coal Resources, Coal Production, and Coal Quality of the Allegheny Group No. 5 Block, and the Pottsville Group Stockton and Coalburg, Winifrede/Hazard, Williamson/Amburgy, Campbell Creek/Upper Elkhorn No. 3, and Upper Elkhorn Nos. 1 and 2/Powellton Coal Zones, Central Appalachian Basin Coal Region

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Kentucky Geological Survey
Tennessee Division of Geology
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2000 RESOURCE ASSESSMENT OF SELECTED COAL BEDS AND ZONES IN THE NORTHERN AND CENTRAL APPALACHIAN BASIN COAL REGIONS

By Northern and Central Appalachian Basin Coal Regions Assessment Team

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By Sandra G. Neuzil[1]

ABSTRACT

The Appalachian Basin coal region is currently, and has been historically, a major producer of coal in the U.S. Coal resource assessment models for six historically important coal beds and coal zones are included in this CD-ROM (Chapters C through H). Five of these six coal zones were fully assessed because correlations between and among the coal beds could be understood, coal extent and mined area maps were available, and a sufficient density of correlated coal stratigraphic data were available to create coal-bed- or coal-zone-specific databases to calculate original and remaining resources. However, there are six additional coal zones in the central Appalachian Basin coal region that are significant contributors to overall U.S. coal production. These six additional coal zones—the No. 5 Block, Stockton and Coalburg, Winifrede/Hazard, Williamson/Amburgy, Campbell Creek/Upper Elkhorn No. 3, and Upper Elkhorn Nos. 1 and 2/Powellton, in order of age from youngest to oldest—produce about 15 percent of the U.S. coal production. Regional stratigraphic relationships between coal beds within these coal zones have been revised many times. Detailed correlated and verified stratigraphic data (drill holes, measured sections, and mine measurements) were not available to develop an assessment model for these coal zones. Current revised regional stratigraphic correlations were utilized to restate coal resources and to compile published data on coal production and coal quality of these coal zones.

Estimates of resources were assembled for coal beds in the Appalachian Basin in 1974. Using revised stratigraphic correlations, coal-bed resource estimates were recorrelated and restated as coal-zone resources in this report. The resource estimates have not been adjusted for coal production due to incomplete acquisition and compilation of coal-bed production data. The restated estimated coal resources for the six coal zones range from 4.6 billion short tons in the Williamson/Amburgy coal zone to 13 billion short tons in the Campbell Creek/Upper Elkhorn No. 3 coal zone. The coal resources greater than 28 in (2.33 ft) thick in the measured and indicated reliability categories in these coal zones range from 350 million short tons in the No. 5 Block coal zone to 5,000 million short tons in the Campbell Creek/Upper Elkhorn No. 3 coal zone. Possible future work by the State geological surveys of Kentucky, West Virginia, Virginia, and Tennessee may allow for updated assessments of original and remaining resources.

Coal production data show that the combined annual production from the six coal zones in 1996 was 160 million short tons, or 15 percent of the total U.S. coal production and 40 percent of the northern and central Appalachian Basin coal regions' coal production. This was a substantial increase from the 1982 production of 105 million short tons from these six coal zones, which constituted 26 percent of the northern and central Appalachian Basin coal regions' production. In 1996, annual coal production from four of these coal zones (the No. 5 Block, Stockton and Coalburg, Campbell Creek/Upper Elkhorn No. 3, and Upper Elkhorn Nos. 1 and 2/Powellton) exceeded 20 million short tons.

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Thus, these six coal zones have made a significant and increasing contribution to the coal mined in the Appalachian Basin and in the U.S.

Ash yield and sulfur contents are medium to low for each coal zone. Ash yield decreases slightly as coal increases in age from a mean of 11.8±5.5 weight percent in the younger No. 5 Block coal zone to 6.8±3.9 weight percent in the older Upper Elkhorn Nos. 1 and 2/Powellton coal zone, on an as-received whole-coal basis. Mean sulfur content for each coal zone ranges from a low of 1.0±0.7 weight percent in the Winifrede/Hazard coal zone to a high of 1.8±1.3 weight percent, on an as-received whole-coal basis in the Williamson/Amburgy coal zone. Mean calorific values increase slightly as coal increases in age from 12,200±1,100 Btu/lb for the No. 5 Block coal zone to 13,500±740 Btu/lb for the Upper Elkhorn Nos. 1 and 2/Powellton coal zone, which is consistent with the decrease in mean ash yield.

Calculated sulfur-dioxide (SO_2) emissions for coal from all six of the coal zones fall both within and above compliance standards of 1.2 pounds of SO_2 emissions per million Btu, as set by the U.S. Environmental Protection Agency (Clean Air Act Amendments of 1990, Public Law 101-549). No data were found that discuss the potential to lower SO_2 emissions by coal cleaning. Mean arsenic contents (remnant-moisture whole-coal basis) for the coal zones, with the exception of the Upper Elkhorn Nos. 1 and 2/Powellton coal zone, are below the average value of 35 ppm reported for all Appalachian Basin coal (Finkelman and others, 1994). Mean arsenic contents range from a low of 14±22 ppm for the Stockton and Coalburg coal zone to a high of 42±90 ppm for the Upper Elkhorn Nos. 1 and 2/Powellton coal zone. Mean mercury content (remnant-moisture whole-coal basis) in all six coal zones is below the average of 0.21 ppm reported for Appalachian Basin coal (Finkelman and others, 1994). Mean mercury contents range from a low of 0.13±0.12 ppm for the Campbell Creek/Upper Elkhorn No. 3 coal zone to a high of 0.18±0.18 ppm for the No. 5 Block coal zone. The range in values for arsenic and mercury content in each coal zone is large, as indicated by the standard deviation values, and apparent differences in mean values may not be significant.

INTRODUCTION

APPROACH

A goal of this work was to create a regional geologic framework within which coal resources, production, and quality could be summarized. Reconciling evolving and differing interpretations of coal-bed and coal-zone correlations (1) across State boundaries, (2) among coal fields and mining or reserve districts within States, and (3) across structural fault zones was necessary in order to accomplish this task. Data for previously available resources, production, and quality were combined for coal beds, coal benches, leader coals, and rider coals within each coal zone. The combination of data was necessary because many of the coal beds in the central Appalachian Basin coal region are geographically discontinuous, either because the coal beds originally were formed as laterally discontinuous lenticular pods, or because the coal beds have been dissected by subsequent erosion. Without detailed stratigraphic control, determining exactly which coal beds are correlative is difficult; therefore, coal beds are correlated by zones. Coal zones are defined by closely spaced coal beds and associated strata that are laterally continuous and can be viewed as a unit (Wood and others, 1983). In the central Appalachian Basin coal region, coal zones are sometimes underlain or overlain by marine members or sandstone units (Chesnut, 1992, 1996; Blake and others, 1994; Rice, 1994; Rice and Hiett, 1994) that delineate the coal zone. Coal-zone and coal-bed correlations are subjective; however, combining all of the coal beds that are stratigraphically within a coal zone assures that the main coal beds that formed at or about the same time are included in the correlation. This approach may inflate the resources and production and obscure the quality of the main coal by including minor coal beds. Because the main, thicker coal beds dominate the resource estimates and coal mine production data, the effect of including lesser coal beds may not greatly affect this information; however, thin coal beds generally have a higher ash yield, sulfur content, and concentration of inorganic constituents than thick coal beds, and coal quality data for the minable and generally thicker coal may be affected by including samples of thin coal beds that would not be mined. Therefore, the ash yield, sulfur content, and inorganic constituents of coal mined from these coal zones may be less than the values reported here.

Methods used to compile the data for coal resources, coal production, and coal quality are described below, followed by a short comment on coalbed methane potential of the coal zones and a detailed discussion of each of the six coal zones. Previously published and here recorrelated coal-zone data are presented in this report. In the past, synthesizing data into a meaningful basin-wide summary was difficult because the data originally were published under numerous coal-bed names, most of which rarely remain the same across State boundaries and sometimes are not even correlative within a State.

This report was prepared as part of a cooperative effort between the U.S. Geological Survey (USGS) and the following State geological surveys (whose abbreviations are used throughout this report): the Kentucky Geological Survey (KGS), the West Virginia Geological and Economic Survey (WVGES), the Virginia Division of Mineral

Resources (VDMR), and the Tennessee Division of Geology (TDG).

CORRELATION OF UNITS

The six coal zones addressed in this chapter are stratigraphically within either the lower part of the Allegheny Group or the upper part of the Pottsville Group (fig. 1). The coal zones are located geographically within the central Appalachian Basin coal region in eastern Kentucky, southern West Virginia, southwest Virginia, and northern Tennessee (figs. 2, 3, and 4; table 1). In eastern Kentucky, the upper part of the Breathitt Group as used by Chesnut (1992) is equivalent to the lower Allegheny Group and upper Pottsville Group (fig. 1). In West Virginia, the upper and middle parts of the Kanawha Formation are in the upper part of the Pottsville Group (fig. 1). In Virginia, the Harlan Formation and the upper part of the Wise Formation occur in the upper Pottsville Group (fig. 1). In Tennessee, the Vowell Mountain, Redoak Mountain, Graves Gap, Indian Bluff, and Slatestone Formations occur in the upper part of the Pottsville Group (fig. 1).

Because of the database entry requirements, data sets for this report are limited to coal zones and the groups in which they occur. Formation and member names are shown in figure 1 and are discussed in the text in order to better understand correlation problems.

In stratigraphically descending order (youngest to oldest), the six coal zones discussed in this chapter are the No. 5 Block, the Stockton and Coalburg, the Winifrede/Hazard, the Williamson/Amburgy, the Campbell Creek/Upper Elkhorn No. 3, and the Upper Elkhorn Nos. 1 and 2/Powellton (fig. 1). The coal zone names used in this report are informal; each name is based on the name(s) of the dominant coal bed(s) in the coal zone in eastern Kentucky and southern West Virginia, with the coal name for the State with the larger resource and (or) production listed first. The correlations used in this report for coal beds within these coal zones incorporate the most recent stratigraphic interpretations available (Hardeman and others, 1966; Rice, 1984, 1994; Blake, 1992, 1998; Chesnut, 1992, 1996, 1997; Blake and others, 1994; Eble, 1994; Nolde, 1994a,b; Rice and Hiett, 1994; Rice, Hiett, and Koozmin, 1994; Bascombe M. Blake, Jr., WVGES, oral commun., 1998; Martino and others, 1998; Zurowski and Miller, 1998; Donald R. Chesnut, Jr., and Cortland F. Eble, KGS, written commun., 1999) and may differ from previous correlations and compilations presented in the literature (Headlee and Nolting, 1940; Wilson and others, 1956; Huddle and others, 1963; Thompson and York, 1975; Tom L. Phillips, University of Illinois (retired), and Russell A. Peppers, Illinois State Geological Survey (retired), written commun., 1983). The reader is referred to figure 1 for details of the correlations within the central Appalachian Basin coal region used in this report.

Correlations between coal beds have evolved with time; for example, the No. 5 Block coal zone in southern West Virginia historically has been correlated with the Lower Kittanning coal bed (fig. 1) in Pennsylvania, Ohio, and northern West Virginia (Headlee and Nolting, 1940). However, recent correlations suggest that the No. 5 Block coal zone in the central Appalachian Basin coal region is stratigraphically below the Lower Kittanning coal bed (Kosanke, 1988; Eble, 1994). This distinction between the Lower Kittanning coal bed and the No. 5 Block coal zone is important because the No. 5 Block coal zone has recently experienced a significant increase in production and is a major contributor to coal produced by mountain-top-removal mining methods in southern West Virginia. Information presented in this report on the No. 5 Block coal zone's resources, production, and quality excludes data for the Lower Kittanning coal bed.

The two uppermost coal zones, the No. 5 Block and the Stockton and Coalburg, may correlate with the Clarion coal bed (Rice, Kosanke, and Henry, 1994) and the Lower Mercer coal bed in Pennsylvania and Ohio (Headlee and Nolting, 1940; Tom L. Phillips, University of Illinois (retired), and Russell A. Peppers, Illinois State Geological Survey (retired), written commun., 1983), respectively, in the northern Appalachian Basin coal region (fig. 1). These correlations are tentative and the equivalent coal beds in the northern Appalachian Basin coal region will not be discussed. The lower four coal zones discussed in this chapter (Winifrede/Hazard, Williamson/Amburgy, Campbell Creek/Upper Elkhorn No. 3, and Upper Elkhorn Nos. 1 and 2/Powellton) do not have correlative coal beds in the northern Appalachian Basin coal region where the Middle Pennsylvanian Series is much thinner and contains fewer coal beds than in the central Appalachian Basin coal region (Eble, 1994).

Names attached to reported coal-bed information in the literature may be confusing or incorrect for several reasons. Stratigraphic correlations in parts of the basin were revised as more information became available, which has led to some confusion in coal-bed nomenclature in southeastern Kentucky (Chesnut, 1997; Rice and Hiett, 1994), southern West Virginia (Blake, 1992, 1998; Blake and others, 1994), Virginia (Nolde, 1994a,b), and Tennessee (Rice, 1984) (fig. 1; Appendix 1). In West Virginia, incorrect coal-bed names have been assigned by mine operators who assumed a one-to-one correspondence of coal beds from one area to a nearby area. This error is prevalent in the stratigraphically higher coal beds in southern West Virginia where the coal industry assumed the age of the youngest coal bed in the isolated mountain tops and assigned coal-bed names sequentially down from the topographically highest bed. Thus, the No. 5 Block coal zone is commonly mined under the names of

						Pennsylvania		West Virginia				
									Kanawha Valley region	Tug Fork region		
							Bituminous coal field		Southern West Virginia coal field	Southern West Virginia coal field	Southern West Virginia coal field	
									Boone, Clay, Fayette, Greenbrier, Kanawha, Nicholas, Raleigh, Wyoming Cos.	Boone, Lincoln, Logan, McDowell, Mingo, Wayne, Wyoming Cos.		
System	Series	Midcontinent Stage	Group (this report)	Code (this report)	Coal Zone Names (this report)	Formation	Formal or informal units	Formation	Divisions of Blake (1998)	Formal or informal units	Formal or informal units	Formal or informal units
		Desmoinesian (part)	Allegheny (part)			Allegheny (part)	Lower Kittanning coal	Charleston Sandstone (part)		No. 6 Block coal (a,b,c)	No. 6 Block coal (a,b,c)	No. 6 Block coal zone (a,b,c)
				13	No. 5 Block coal zone		Clarion coal (?)			No. 5 Block coal (a,b,c)	No. 5 Block coal (a,b,c)	No. 5 Block coal zone (a,b,c)
							Brookville coal (?)			Little No. 5 Block coal (c)	Little No. 5 Block coal (c)	Little No. 5 Block coal (c)
										Stockton "A" coal (c)	Stockton "A" coal (c)	Stockton "A" coal (c)
		Atokan					Homewood Sandstone Member		upper	Kanawha black flint of White (1891)	Kanawha black flint of White (1891)	Kanawha black flint of White (1891)
				14	Stockton and Coalburg coal zone		Lower Mercer coal (?)			Stockton coal	Stockton coal	Stockton coal zone (c,d)
				15						Coalburg coal	Coalburg coal	Coalburg coal zone (c,d)
										Arnett Member (d)	Arnett Member (d)	Arnett Member (d)
				16	Winifrede/Hazard coal zone					Winifrede coal (d,e)	Winifrede, Buffalo Creek coals (d,e)	Winifrede coal zone (c,d,f)
				17						Lower Winifrede coal (d,e)	Lower Winifrede, Lower Buffalo Creek coals (d,e)	

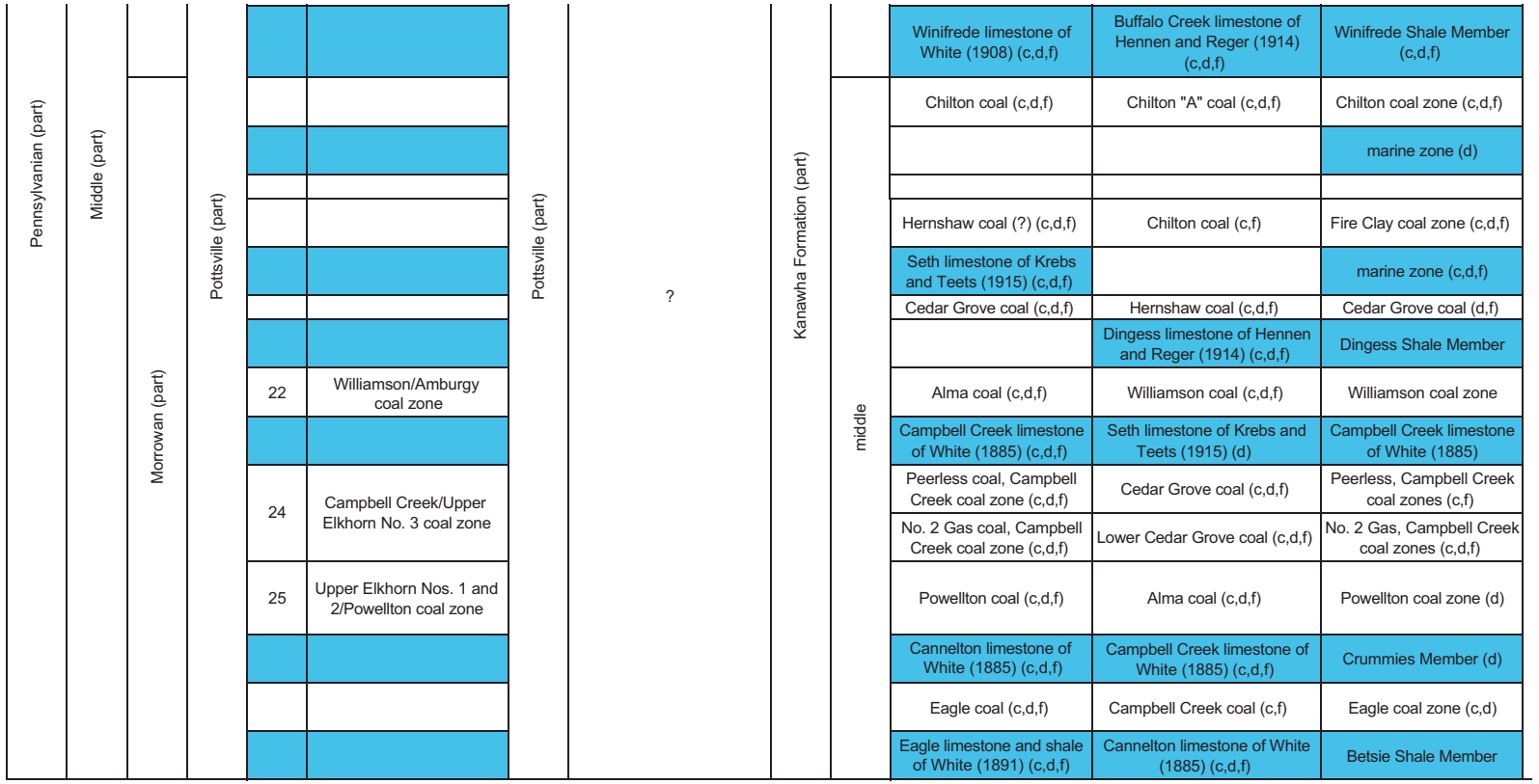
A

Figure 1. Chart showing correlation of coal zones in part of the Middle Pennsylvanian Series in the northern and central Appalachian Basin coal regions, from the northeast to the southwest. Stratigraphic relationships and coal-zone correlations are indicated for southern West Virginia, eastern Kentucky, southwestern Virginia, and northern Tennessee. ***A***, Upper left quadrant of chart; ***B***, Upper right quadrant of chart; ***C***, Lower left quadrant of chart; ***D***, Lower right quadrant of chart; for a complete image of the chart, click here. Formal and informal unit names, stratigraphic relationships, and coal zone correlations are drawn from Rice, Hiett, and Koozmin (1994); also see references therein, except as noted: a, Kosanke (1988); b, Eble (1994); c, Blake (1992); d, Blake (1998); e, Donald R. Chesnut, Jr., and Cortland F. Eble (KGS, written commun., 1999); f, Blake and others (1994); g, Chesnut (1992); h, Chesnut (1997); i, Nolde (1994a); j, Nolde (1994b); k, Charles L. Rice (USGS retired, oral commun., 1999); and l, Rice (1984). This correlation chart is generalized and not all units are shown. 'Coal' indicates coal bed. Coal zones are noted. Query indicates uncertain correlation of this unit. Empty formal or informal unit boxes indicate no significant unit present at this horizon. Unshaded units are coal. Shaded units are clastic and carbonate sedimentary units; many are marine in origin. Where two coal bed names appear in one block, both are considered to be in the same coal zone in this study. 'Marine zone' indicates presence of unnamed marine zone. Boxes are not to scale and do not imply length of time, thickness of interval, or areal extent of unit. 'Group (this report)' indicates stratigraphic group names used throughout the northern and central Appalachian Basin coal resource assessment reports for data entry purposes. 'Code (this report)' indicates code used in this chapter for data entry purposes.

Kentucky				Virginia			Tennessee		
			Harlan subdistrict						
		Hazard and Big Sandy reserve districts	Upper Cumberland River reserve district					Jellico area	Walnut Mountain area
		Eastern Kentucky coal field	Eastern Kentucky coal field			Southwest Virginia coal field		west of Cumberland overthrust sheet	Cumberland overthrust sheet
		Breathitt, Floyd, Harlan, Johnson, Knott, Leslie, Letcher, Martin, Perry, Pike Cos.	Bell, Harlan, Letcher Cos.			western Buchanan, Dickenson, Lee, Wise Cos.		Anderson, Campbell, Morgan, Scott Cos.	Campbell, Claiborne Cos.
Group as used by Chesnut (1992)	Formations of Chesnut (1992)	Formal or informal units	Formal or informal units	Formation	Informal division of Nolde (1994a)	Formal or informal units	Formation of Wilson and others (1956) as revised by Hardeman and others (1966)	Formal or informal units	Formal or informal units
	Princess (part)	eroded	eroded			eroded		eroded	eroded
		Richardson, Skyline coal zones (g,h)							
				Harlan					
		Stoney Fork Member (?) (g)							
	Four Corners	Broas coal zone (e,g,h)	Black Mountain coal zone (h)			No. 13 coal			
		Peach Orchard coal zone (e,g,h)	High Splint coal zone (h)			High Splint coal (i)	Vowell Mountain (part)	Hazard No. 9 (?) (k)	
		Arnett Member (h)							
		Hazard coal zone (h)	Morris coal zone (h)			Morris, No. 11 coals (i,j)		Braden Mountain, Pewee coals (l)	
		Haddix coal zone (h)	Lower Highsplint coal (h)			Reynolds Sandstone Member (i,j)		Red Ash coal	
			Reynolds Sandstone Member (h)					Fodderstack Sandstone Member	

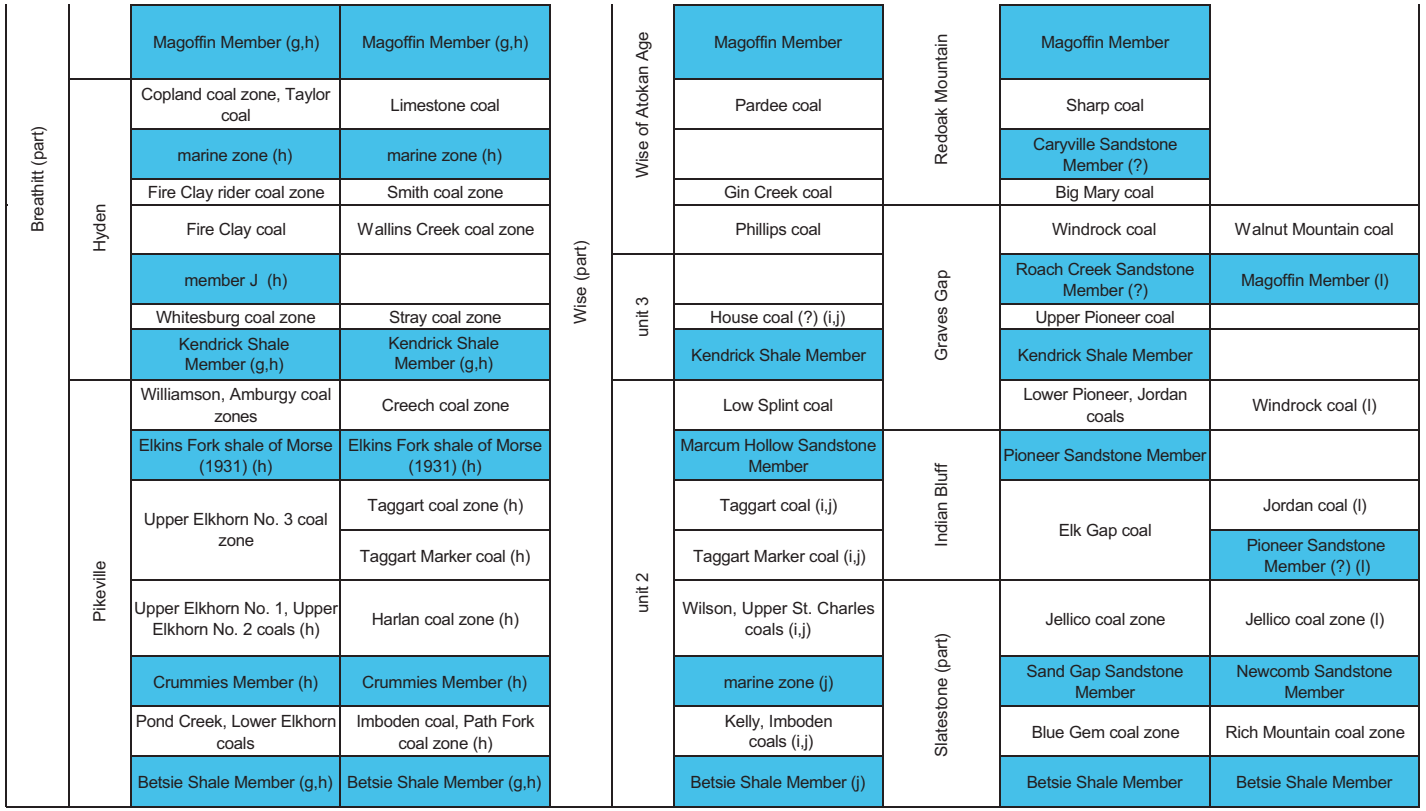
B

Figure 1.—Continued.



C

Figure 1.—Continued.



D

Figure 1.—Continued.

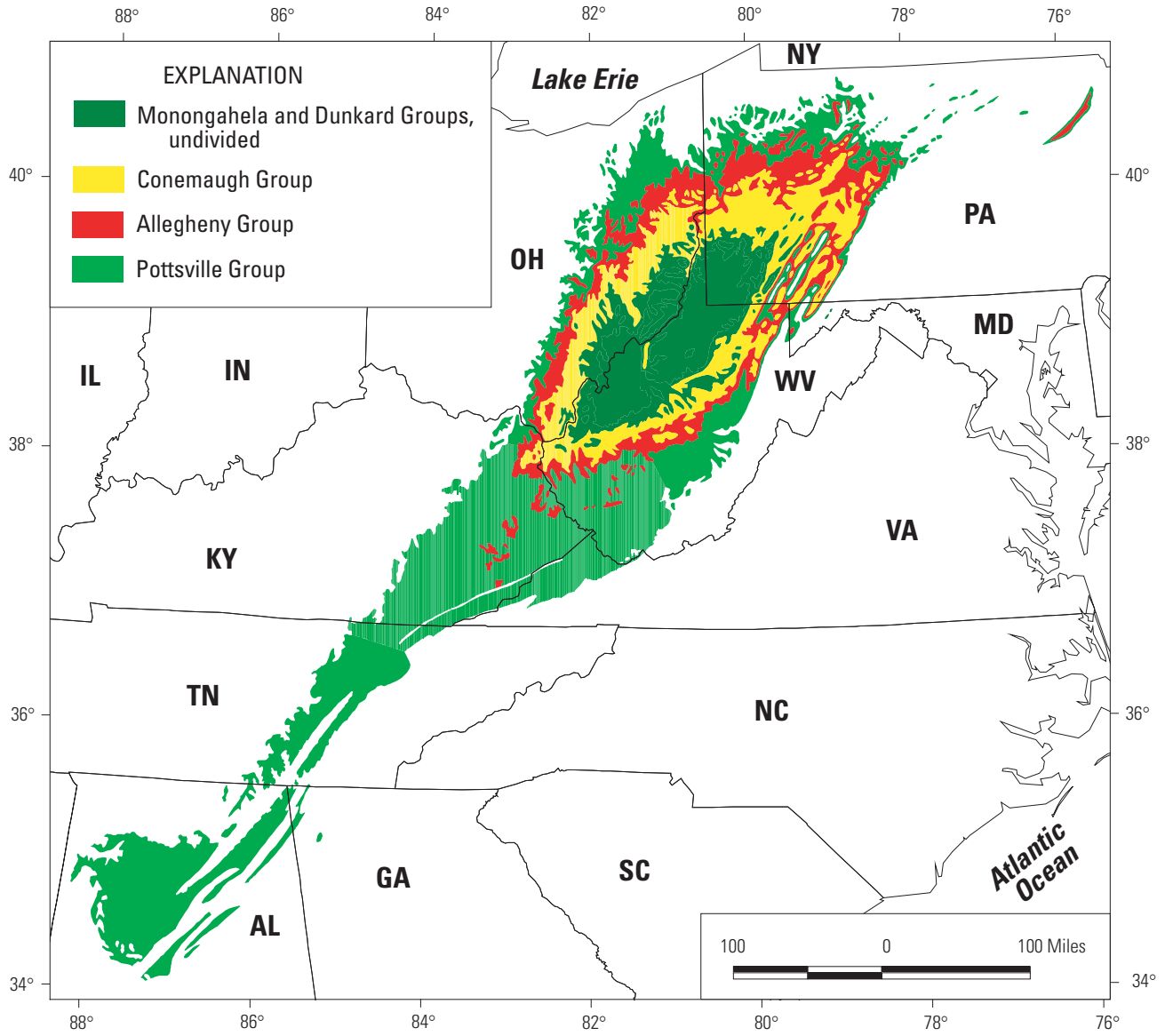


Figure 2. Map showing the Pennsylvanian and Permian Systems in part of the Appalachian Basin modified from C. Blaine Cecil and others (USGS, unpub. data, 1999). The use of these group names is for data-entry purposes only and does not imply changes to nomenclature. See figure 1.

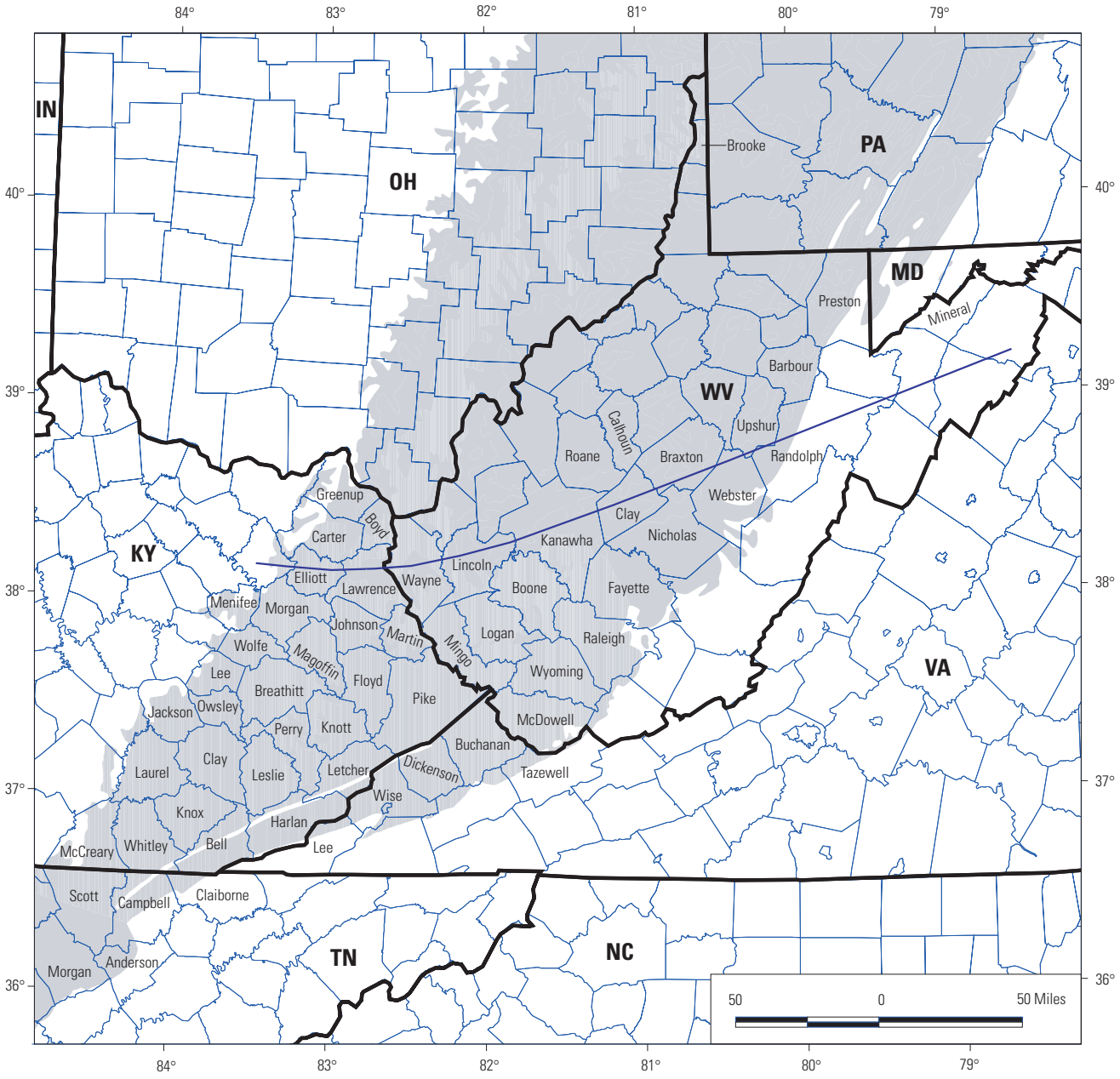


Figure 3. Map showing counties in the central Appalachian Basin coal region. Gray area represents the central Appalachian Basin coal region and parts of the northern and southern Appalachian Basin coal regions. Curved line marks the approximate boundary of the northern and central Appalachian Basin coal regions. Barbour, Brooke, Calhoun, Mineral, Preston, and Roane Counties, W. Va., are not in the central Appalachian Basin coal region; however, some coal data from those counties are discussed in this report. See table 1.

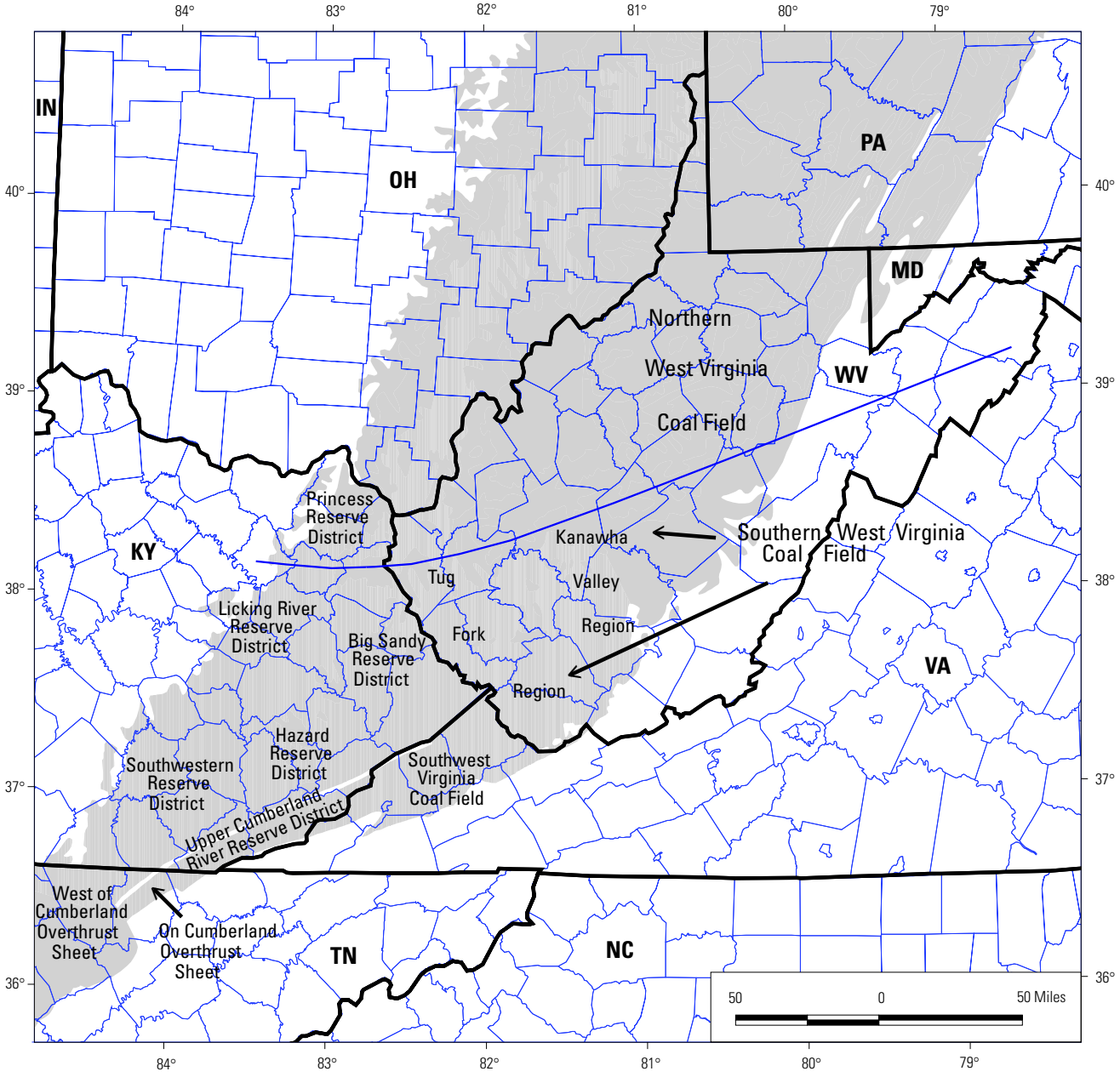


Figure 4. Map showing the generalized locations of the reserve districts, coal fields, and geographic regions in southern West Virginia, eastern Kentucky, southwestern Virginia, and northern Tennessee in the central Appalachian Basin coal region. Curved line marks the approximate boundary of the northern and central Appalachian Basin coal regions. See table 1 for details.

Table 1. Counties of the central Appalachian Basin coal region discussed in this report; their State reserve districts, coal fields, or geographic regions; and decade of maximum production.

[Data from Milici (1999, sheet 1; also see Chapter A, Appendix 1, this report). Abbreviations are as follows: St., State; nd, no data available or absence of production.]

State	County	District, subdistrict, coal field, or geographic region	Decade of maximum coal production	Notes
KY	Bell	Southwestern reserve district and Upper Cumberland River reserve district (Middlesboro and Harlan subdistricts)	1980 – 1989	
KY	Boyd	Princess reserve district	1980 – 1989	
KY	Breathitt	Hazard reserve district	1980 – 1989	
KY	Carter	Princess reserve district	1940 – 1949	
KY	Clay	Southwestern reserve district	1980 – 1989	
KY	Elliott	Licking River reserve district	1980 – 1989	
KY	Floyd	Big Sandy reserve district	1990 – 1996	
KY	Greenup	Princess reserve district	1990 – 1996	
KY	Harlan	Hazard reserve district and Upper Cumberland River reserve district (Harlan subdistrict)	1930 – 1939	
KY	Jackson	Southwestern reserve district	1970 – 1979	
KY	Johnson	Big Sandy reserve district	1970 – 1979	
KY	Knott	Hazard reserve district	1990 – 1996	
KY	Knox	Southwestern reserve district	1980 – 1989	
KY	Laurel	Southwestern reserve district	1980 – 1989	
KY	Lawrence	Princess reserve district	1970 – 1979	
KY	Lee	Southwestern reserve district	1950 – 1959	
KY	Leslie	Hazard reserve district	1990 – 1996	
KY	Letcher	Hazard reserve district and Upper Cumberland River reserve district (Harlan subdistrict)	1940 – 1949	
KY	Magoffin	Licking River reserve district	1980 – 1989	
KY	Martin	Big Sandy reserve district	1980 – 1989	
KY	McCreary	Southwestern reserve district	1980 – 1989	
KY	Menifee	Licking River reserve district	1940 – 1949	
KY	Morgan	Licking River reserve district	1970 – 1979	
KY	Owsley	Southwestern reserve district	1970 – 1979	
KY	Perry	Hazard reserve district	1990 – 1996	
KY	Pike	Big Sandy reserve district	1990 – 1996	
KY	Whitley	Southwestern reserve district and Upper Cumberland River reserve district (Middlesboro subdistrict)	1970 – 1979	
KY	Wolfe	Licking River reserve district	1990 – 1996	
TN	Anderson	west of Cumberland overthrust sheet	1970 – 1979	
TN	Campbell	Cumberland overthrust sheet and west of Cumberland overthrust sheet	1970 – 1979	
TN	Claiborne	Cumberland overthrust sheet and west of Cumberland overthrust sheet	1970 – 1979	
TN	Morgan	west of Cumberland overthrust sheet	1970 – 1979	
TN	Scott	west of Cumberland overthrust sheet	1980 – 1989	
VA	Buchanan	Southwest Virginia coal field	1990 – 1996	
VA	Dickerson	Southwest Virginia coal field	1960 – 1969	
VA	Lee	Southwest Virginia coal field	1990 – 1996	
VA	Tazewell	Southwest Virginia coal field	1940 – 1949	
VA	Wise	Southwest Virginia coal field	1980 – 1989	

Table 1.—Continued

State	County	District, subdistrict, coal field, or geographic region	Decade of maximum coal production	Notes
WV	Boone	Tug Fork and Kanawha Valley regions	1990 – 1996	
WV	Braxton	southern West Virginia coal field	1980 – 1989	Revised correlation of coal beds in this county
WV	Clay	Kanawha Valley region	1990 – 1996	
WV	Fayette	Kanawha Valley region	1940 – 1949	
WV	Kanawha	Kanawha Valley region	1970 – 1979	
WV	Lincoln	Tug Fork region	1990 – 1996	
WV	Logan	Tug Fork region	1940 – 1949	
WV	McDowell	Tug Fork region	1940 – 1949	
WV	Mingo	Tug Fork region	1990 – 1996	
WV	Nicholas	Kanawha Valley region	1980 – 1989	
WV	Raleigh	Kanawha Valley region	1940 – 1949	
WV	Randolph	southern West Virginia coal field	1940 – 1949	Uncertain correlation of coal beds in this county
WV	Upshur	southern West Virginia coal field	1980 – 1989	Uncertain correlation of coal beds in this county
WV	Wayne	Tug Fork region	1990 – 1996	
WV	Webster	southern West Virginia coal field	1990 – 1996	Revised correlation of coal beds in this county
WV	Wyoming	Tug Fork and Kanawha Valley regions	1960 – 1969	
The following counties are not in the central Appalachian Basin coal region; however, some coal information is discussed in this report				
WV	Barbour	northern West Virginia coal field	1970 – 1979	
WV	Brooke	northern West Virginia coal field	1940 – 1949	
WV	Calhoun	northern West Virginia coal field	nd	
WV	Mineral	northern West Virginia coal field	1910 – 1919	
WV	Preston	northern West Virginia coal field	1980 – 1989	
WV	Roane	northern West Virginia coal field	nd	

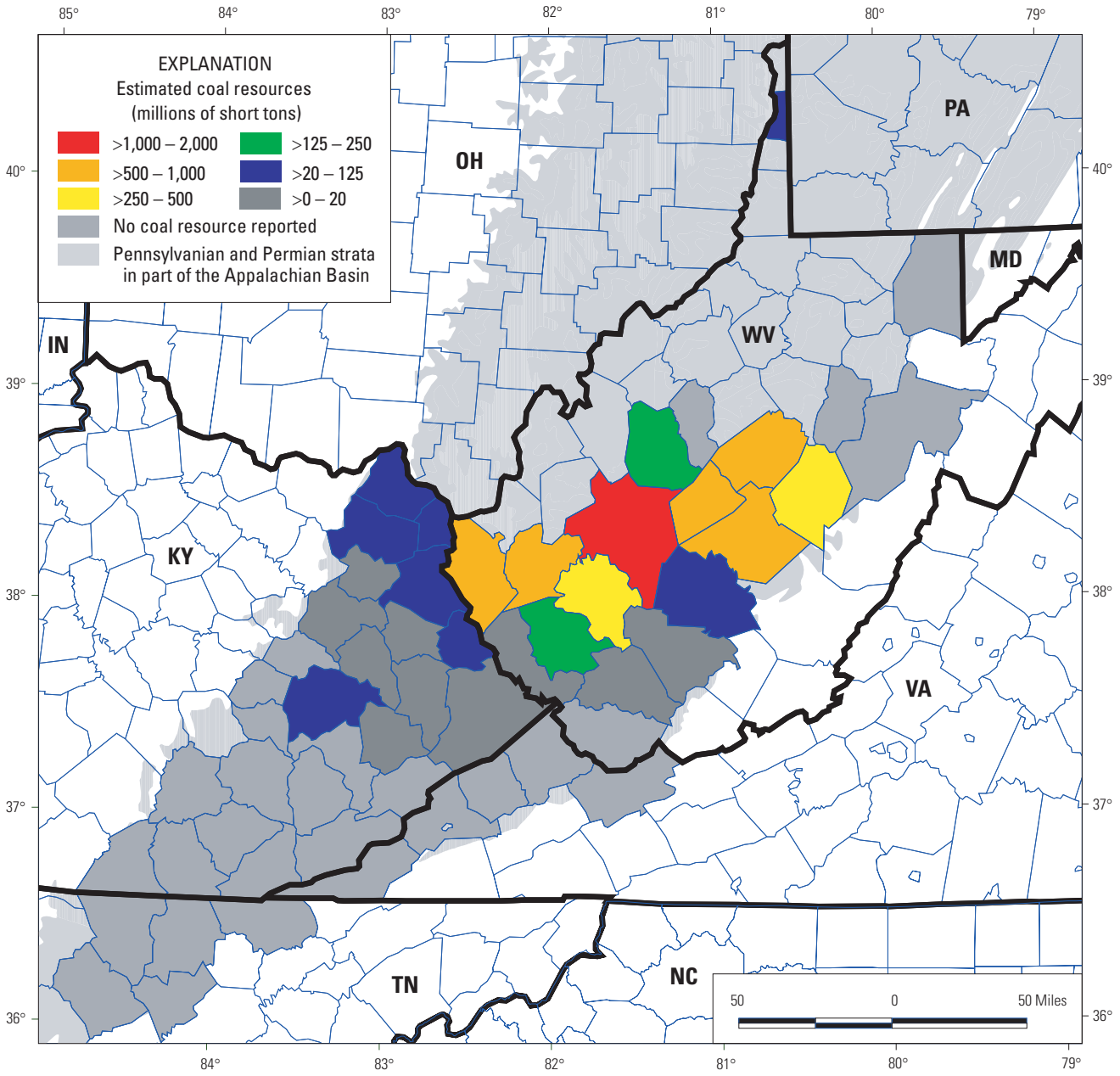


Figure 5. Map showing estimated coal resources of the No. 5 Block coal zone, by county, in the central Appalachian Basin coal region (in millions of short tons), remaining in the ground as of January 1, 1974. Data are from Appendix 5 (table A5–1). See figure 3 for county names. Source: Appendix 3.

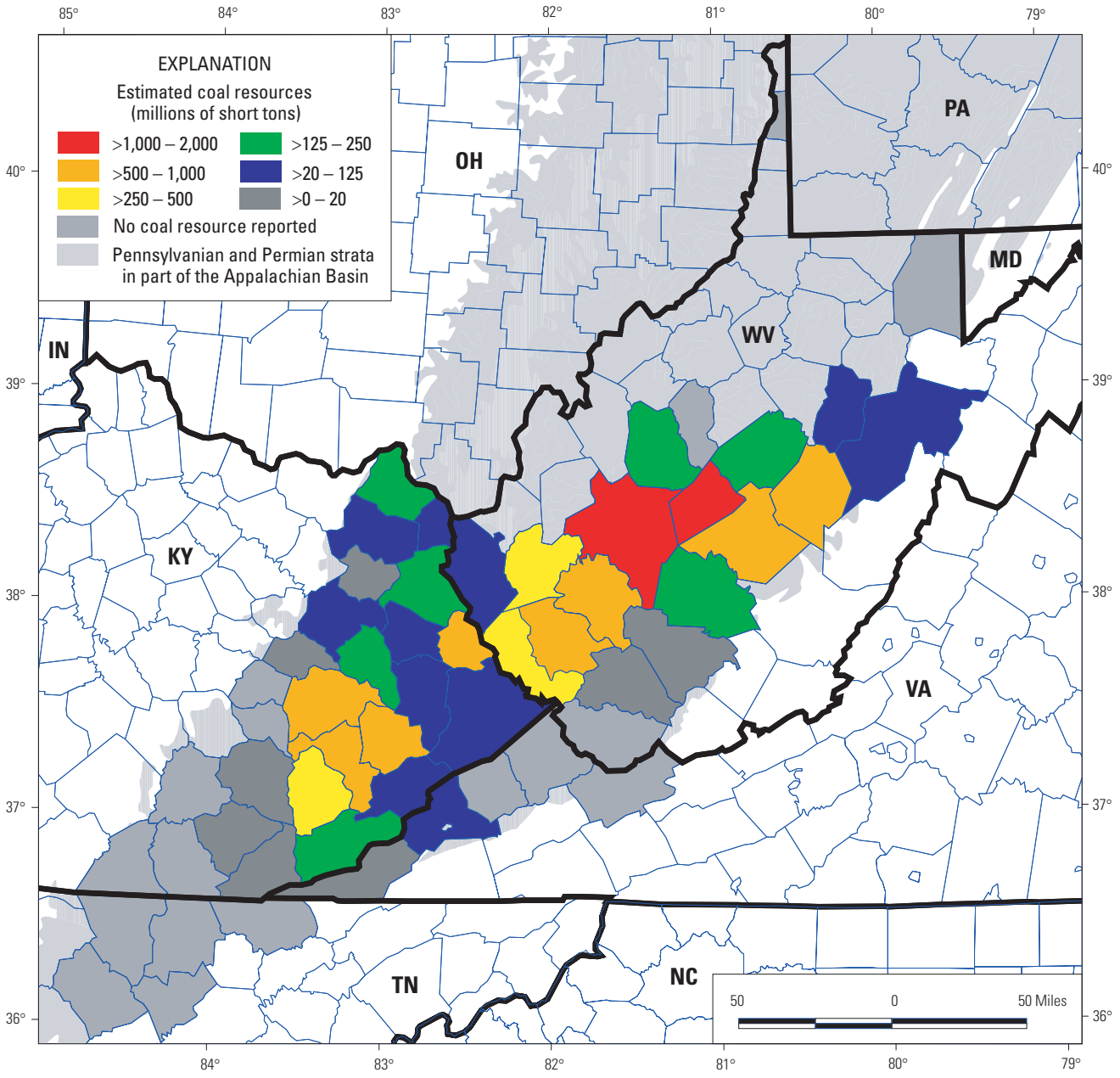


Figure 6. Map showing estimated coal resources of the Stockton and Coalburg coal zone, by county, in the central Appalachian Basin coal region (in millions of short tons), remaining in the ground as of January 1, 1974. Data are from Appendix 5 (table A5–2). See figure 3 for county names. Source: Appendix 3.

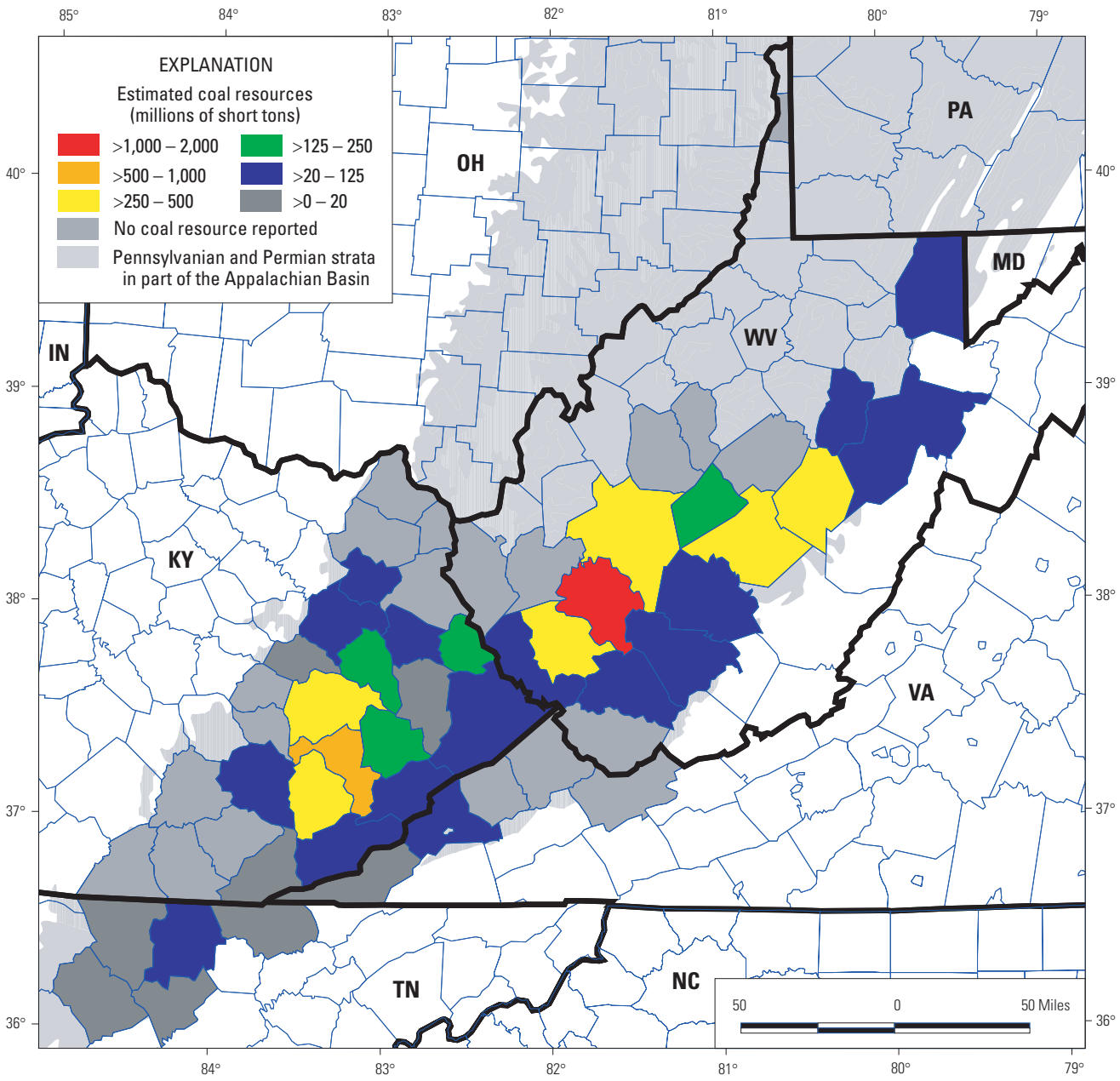


Figure 7. Map showing estimated coal resources of the Winifrede/Hazard coal zone, by county, in the central Appalachian Basin coal region (in millions of short tons), remaining in the ground as of January 1, 1974. Data are from Appendix 5 (table A5–3). See figure 3 for county names. Source: Appendix 3.

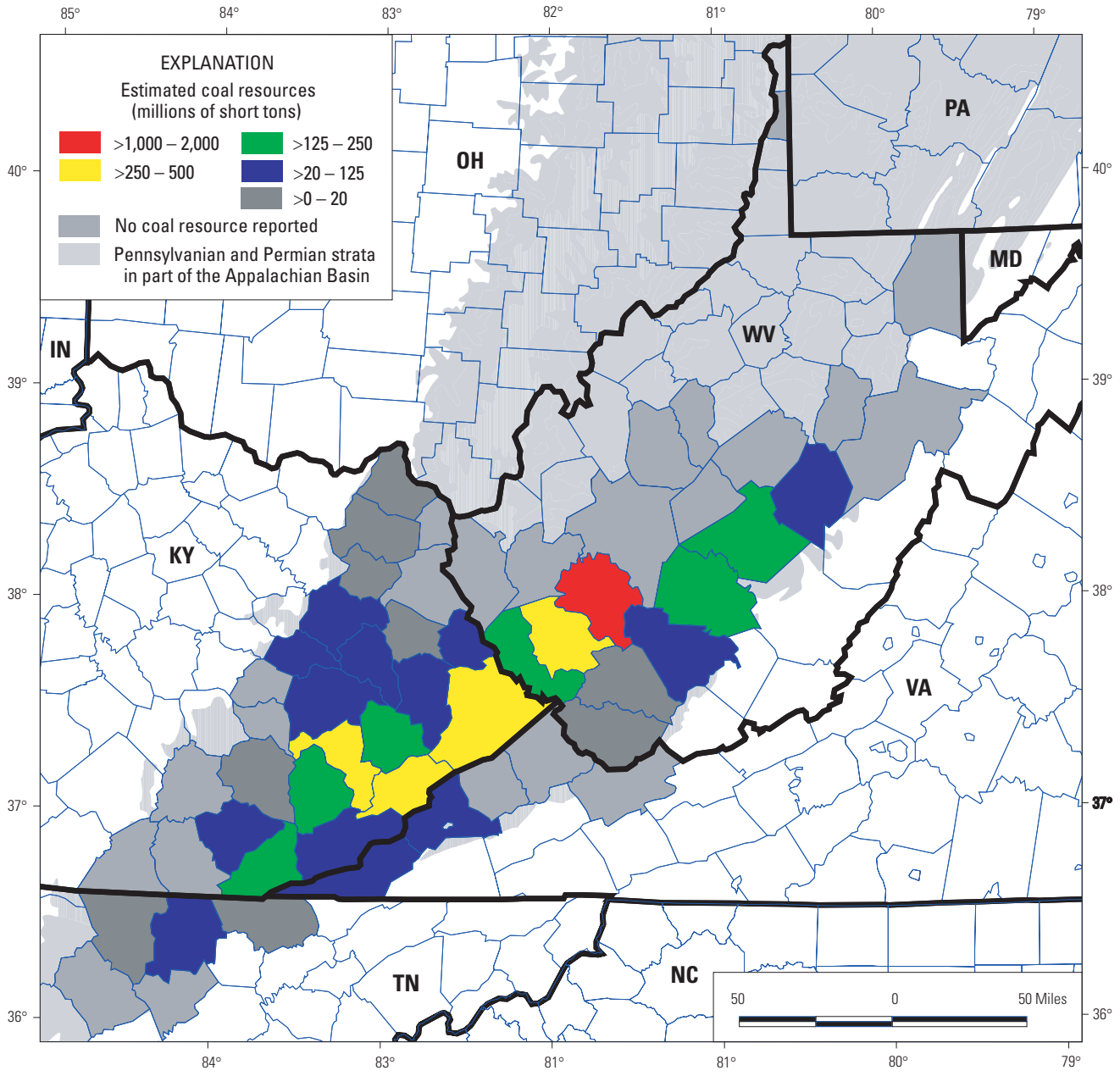


Figure 8. Map showing estimated coal resources of the Williamson/Amburgy coal zone, by county, in the central Appalachian Basin coal region (in millions of short tons), remaining in the ground as of January 1, 1974. Data are from Appendix 5 (table A5–4). See figure 3 for county names. Source: Appendix 3.

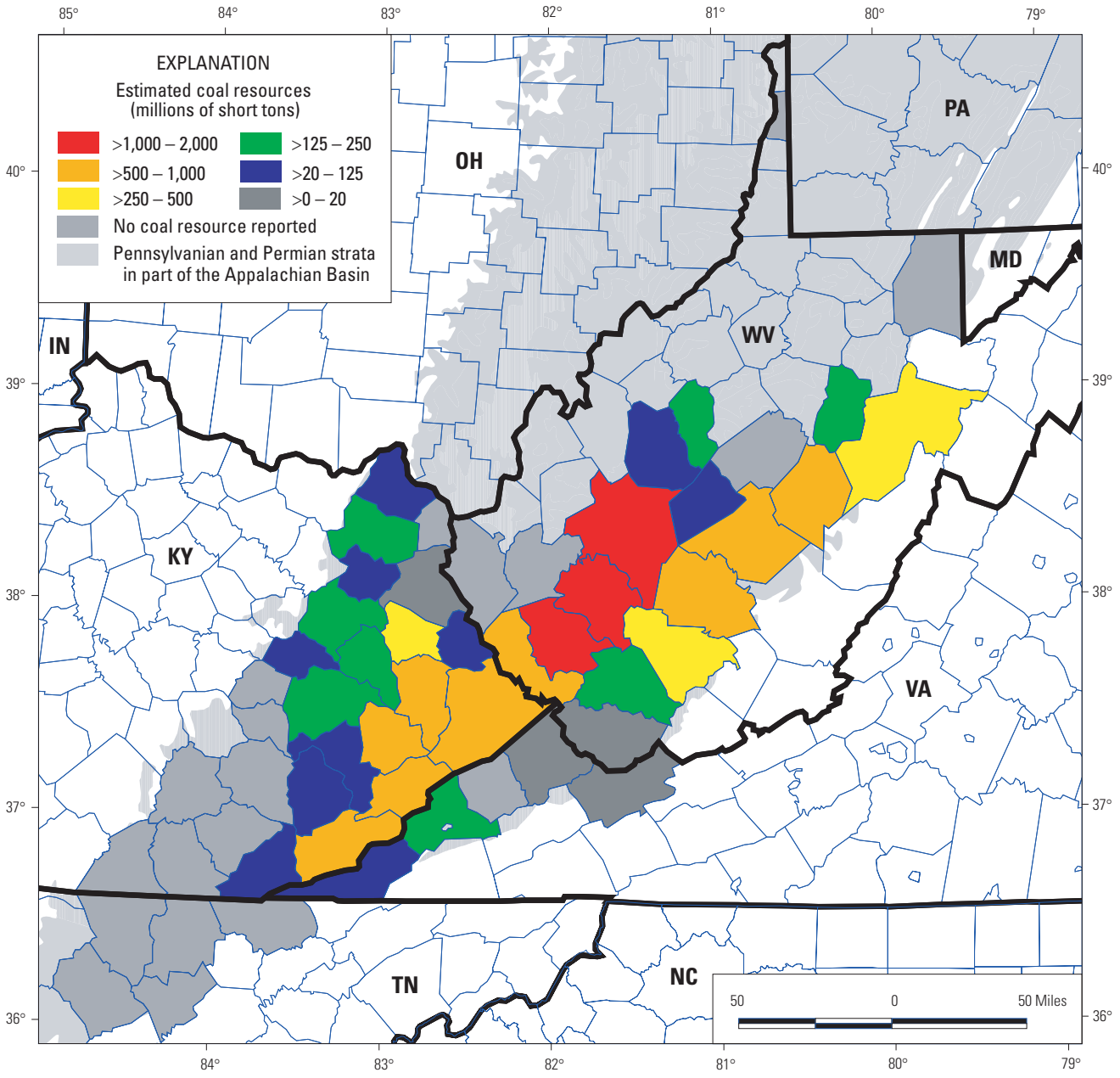


Figure 9. Map showing estimated coal resources of the Campbell Creek/Upper Elkhorn No. 3 coal zone, by county, in the central Appalachian Basin coal region (in millions of short tons), remaining in the ground as of January 1, 1974. Data are from Appendix 5 (table A5–5). See figure 3 for county names. Source: Appendix 3.

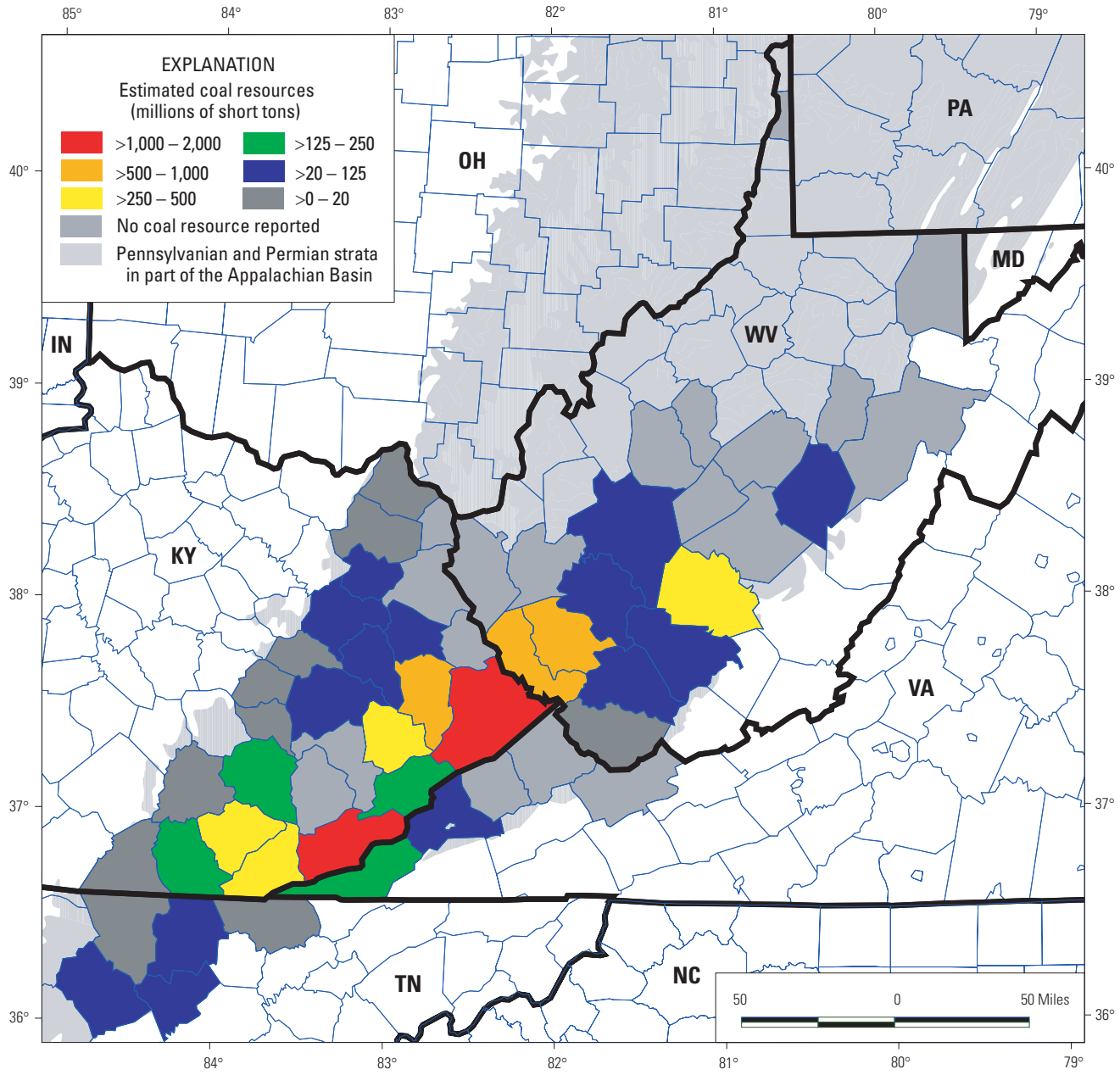


Figure 10. Map showing estimated coal resources of the Upper Elkhorn Nos. 1 and 2/Powellton coal zone, by county, in the central Appalachian Basin coal region (in millions of short tons), remaining in the ground as of January 1, 1974. Data are from Appendix 5 (table A5–6). See figure 3 for county names. Source: Appendix 3.

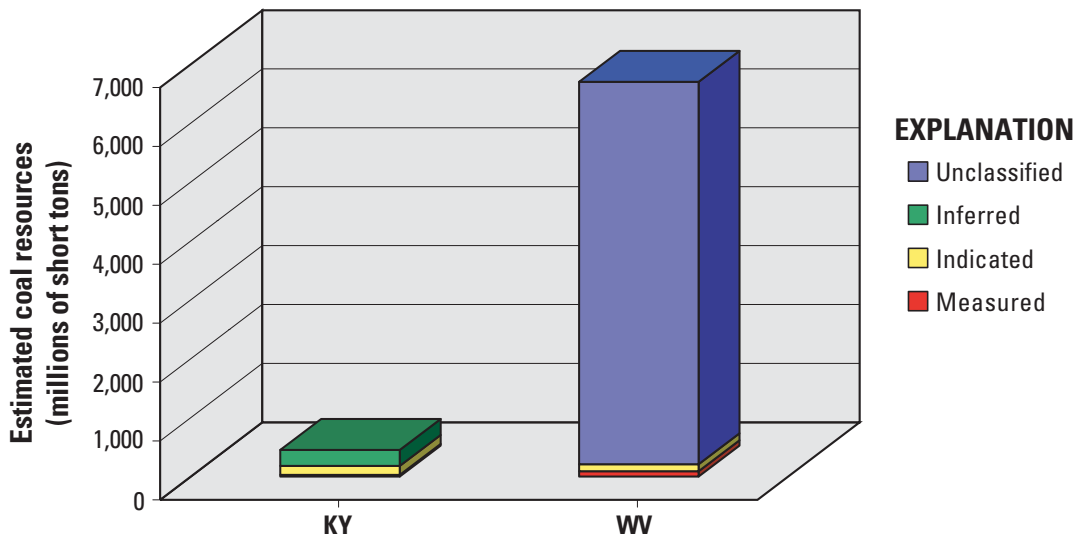


Figure 11. Bar graph showing estimated coal resources, by State and by reliability category, for the No. 5 Block coal zone in the central Appalachian Basin coal region (in millions of short tons), remaining in the ground as of January 1, 1974. Data are from Appendix 6 (table A6–1). Source: Appendix 3.

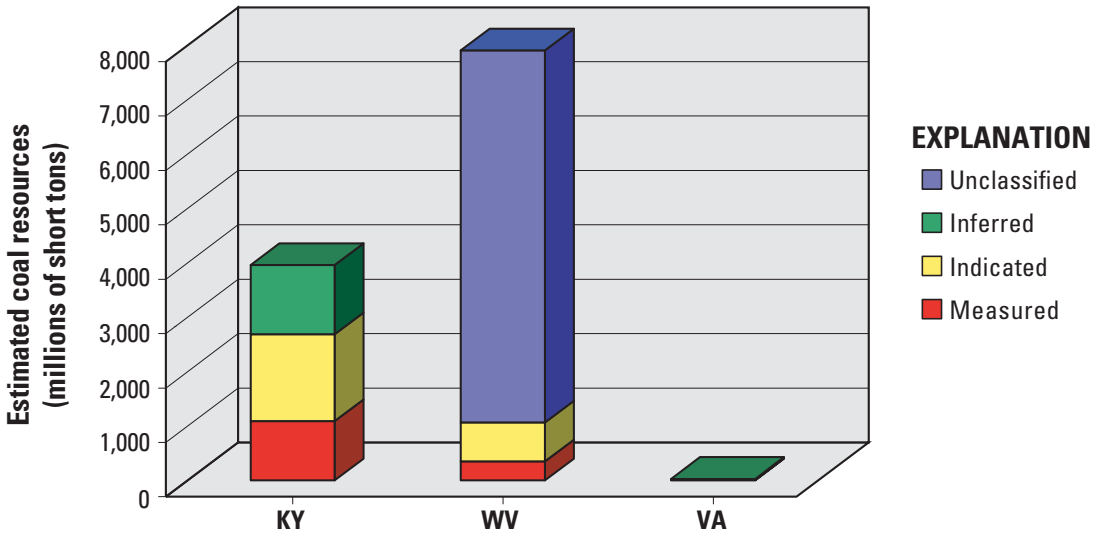


Figure 12. Bar graph showing estimated coal resources, by State and by reliability category, for the Stockton and Coalburg coal zone in the central Appalachian Basin coal region (in millions of short tons), remaining in the ground as of January 1, 1974. Data are from Appendix 6 (table A6–2). Source: Appendix 3.

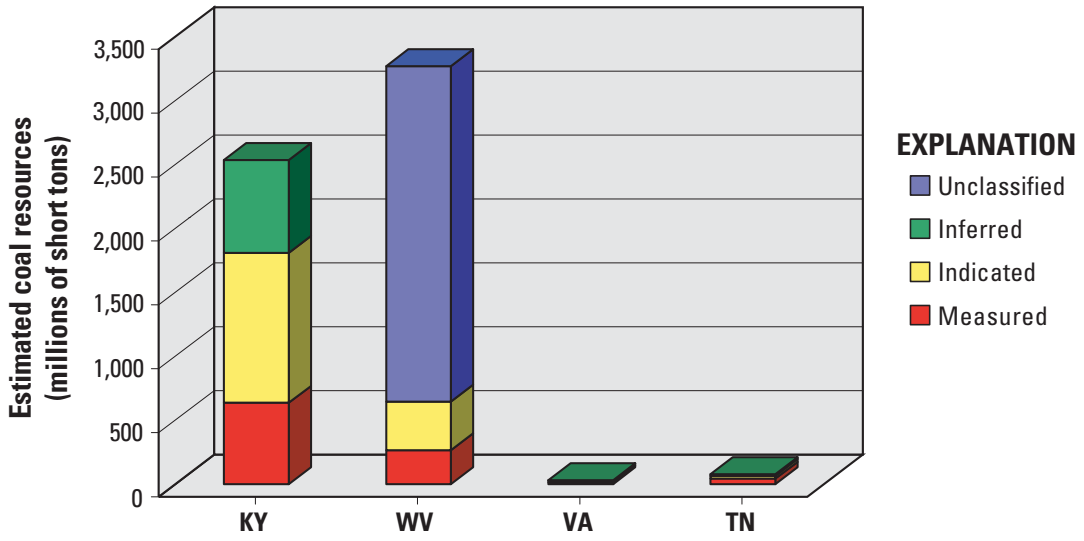


Figure 13. Bar graph showing estimated coal resources, by State and by reliability category, for the Winifrede/Hazard coal zone in the central Appalachian Basin coal region (in millions of short tons), remaining in the ground as of January 1, 1974. Data are from Appendix 6 (table A6–3). Source: Appendix 3.

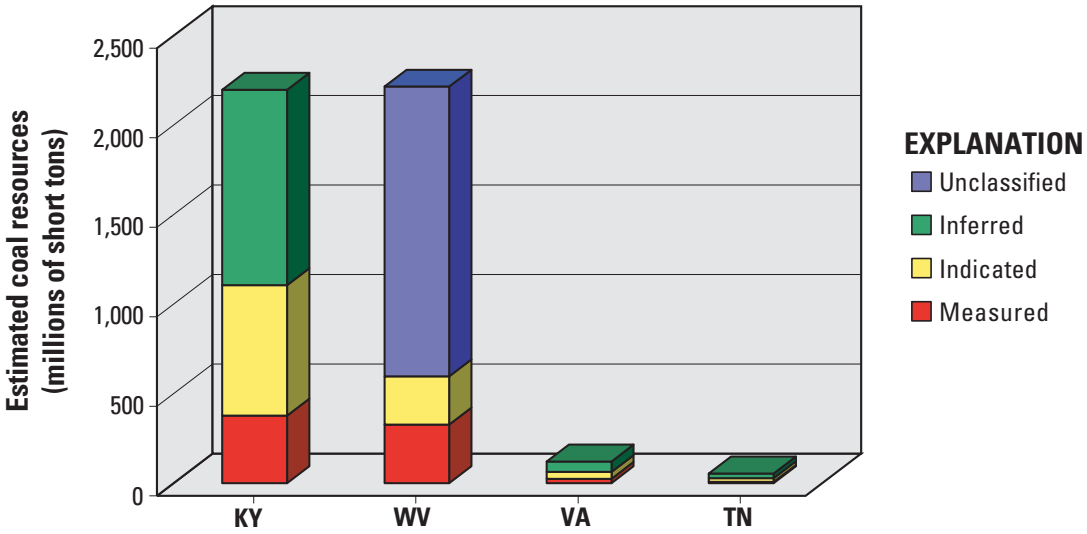


Figure 14. Bar graph showing estimated coal resources, by State and by reliability category, for the Williamson/Amburgy coal zone in the central Appalachian Basin coal region (in millions of short tons), remaining in the ground as of January 1, 1974. Data are from Appendix 6 (table A6–4). Source: Appendix 3.

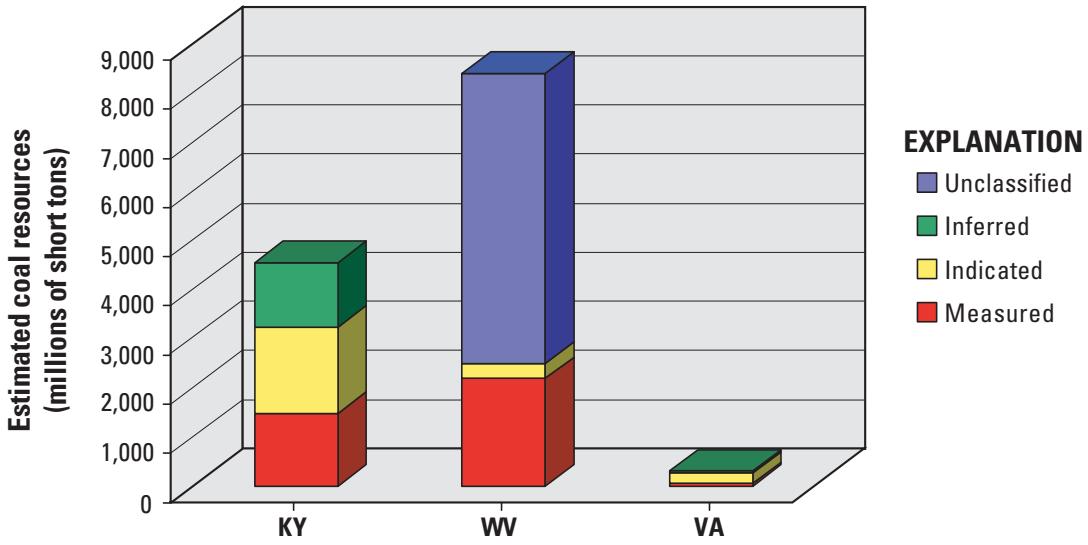


Figure 15. Bar graph showing estimated coal resources, by State and by reliability category, for the Campbell Creek/Upper Elkhorn No. 3 coal zone in the central Appalachian Basin coal region (in millions of short tons), remaining in the ground as of January 1, 1974. Data are from Appendix 6 (table A6–5). Source: Appendix 3.

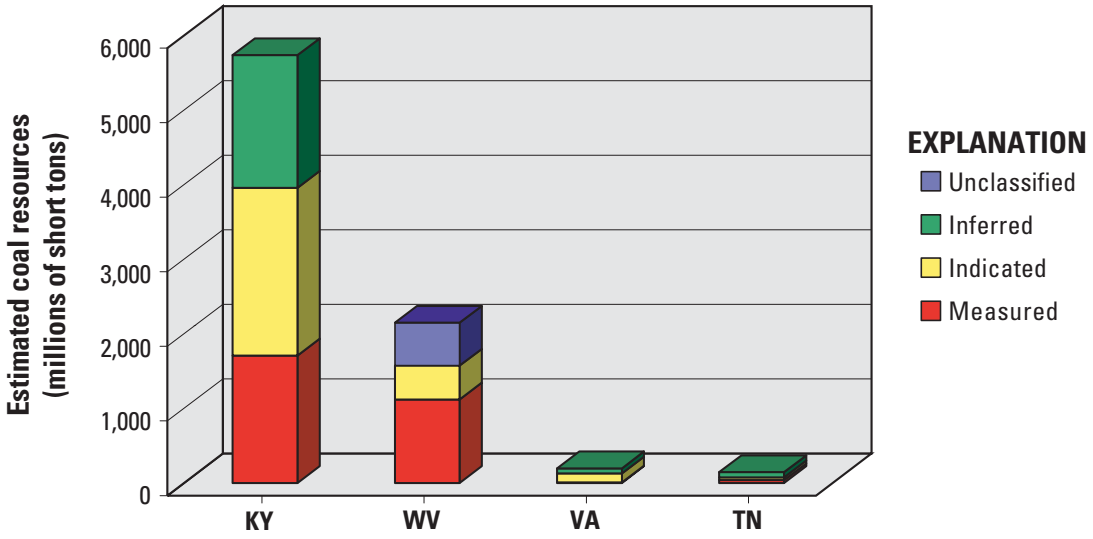


Figure 16. Bar graph showing estimated coal resources, by State and by reliability category, for the Upper Elkhorn Nos. 1 and 2/Powellton coal zone in the central Appalachian Basin coal region (in millions of short tons), remaining in the ground as of January 1, 1974. Data are from Appendix 6 (table A6–6). Source: Appendix 3.

Table 2. Summary data for coal resources, coal production, and coal quality means and standard deviations, for each coal zone.

[Means and standard deviations for coal quality analyses (ash yield, sulfur content, gross calorific value, and sulfur-dioxide emissions) were determined on an as-received whole-coal basis; those for arsenic and mercury contents were determined on a remnant-moisture whole-coal basis. Abbreviations are as follows: mst, millions of short tons; %, percent; ppm, parts per million; s.d., standard deviation. Source: Data compiled from Appendixes 6, 9, and 11 through 16, this chapter.]

Coal zone name	Resources as of Jan. 1, 1974 (mst)	Resources > 2.33 ft in Measured and Indicated Reliability Categories (mst)	1982 Production (mst)	1996 Production (mst)	Ash Yield (weight percent) mean	Ash Yield (weight percent) s.d.	Sulfur Content (weight percent) mean	Sulfur Content (weight percent) s.d.	Gross Calorific Value (Btu/lb) mean	Gross Calorific Value (Btu/lb) s.d.	Sulfur Dioxide Content (lbs/million Btu) mean	Sulfur Dioxide Content (lbs/million Btu) s.d.	Arsenic Content (ppm) mean	Arsenic Content (ppm) s.d.	Mercury Content (ppm) mean	Mercury Content (ppm) s.d.
No. 5 Block	7,200	350	~15	23	11.8	5.5	1.2	0.9	12,200	1,100	1.9	1.5	14	24	0.18	0.18
Stockton and Coalburg	12,000	3,200	41	53	11.4	5.6	1.3	1.0	12,300	1,000	2.1	1.7	14	22	0.15	0.13
Winifrede/Hazard	5,900	1,800	16	17	10.1	5.9	1.0	0.7	12,800	1,000	1.7	1.2	15	37	0.15	0.17
Williamson/Amburgy	4,600	1,200	5.6	8.8	8.8	5.0	1.8	1.3	13,100	830	2.9	2.2	29	35	0.14	0.11
Campbell Creek/Upper Elkhorn No. 3	13,000	5,000	20	32	7.3	3.9	1.4	1.0	13,500	780	2.0	1.5	17	26	0.13	0.12
Upper Elkhorn Nos. 1 and 2/Powellton	8,200	4,300	13	29	6.8	3.9	1.6	1.3	13,500	740	2.4	2.0	42	90	0.16	0.14
Appendix in this chapter for details	6	6	9	9	11	11	12	12	13	13	14	14	15	15	16	16

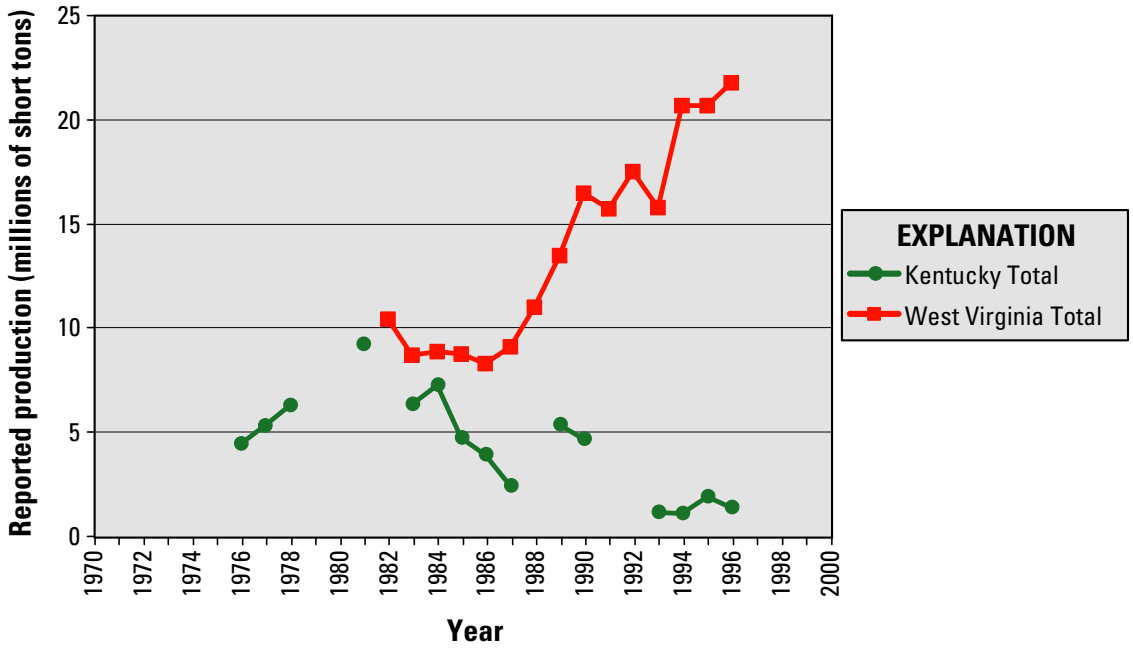


Figure 17. Graph showing annual coal production of the No. 5 Block coal zone, by State (in millions of short tons). Data are from Appendix 9 (table A9–1). Source: Appendix 7.

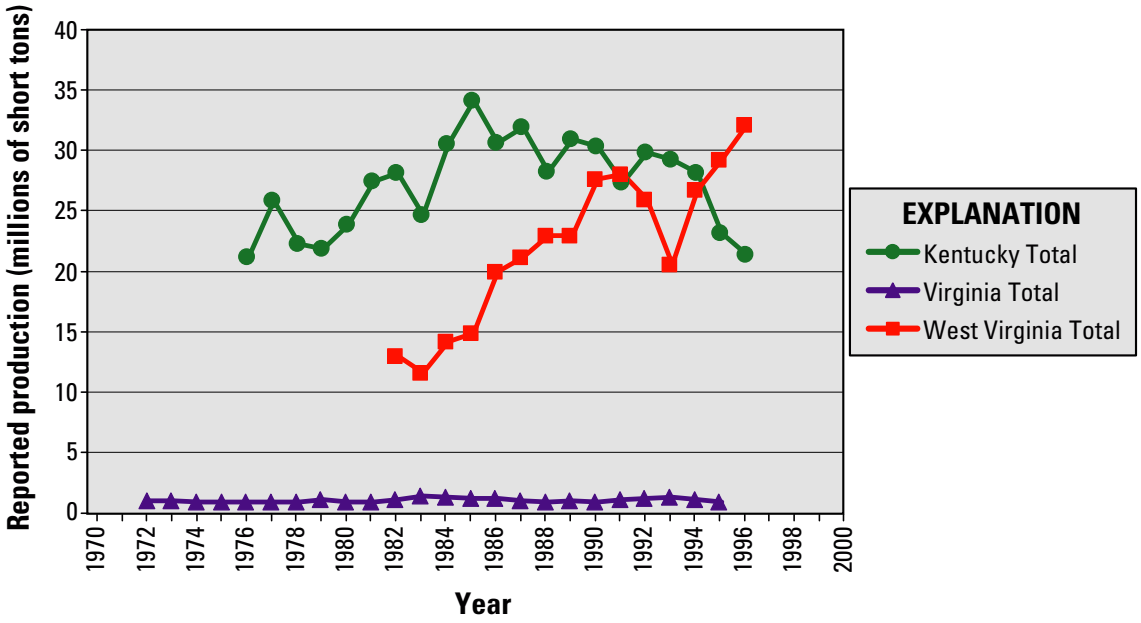


Figure 18. Graph showing annual coal production of the Stockton and Coalburg coal zone, by State (in millions of short tons). Data are from Appendix 9 (table A9–2). Source: Appendix 7.

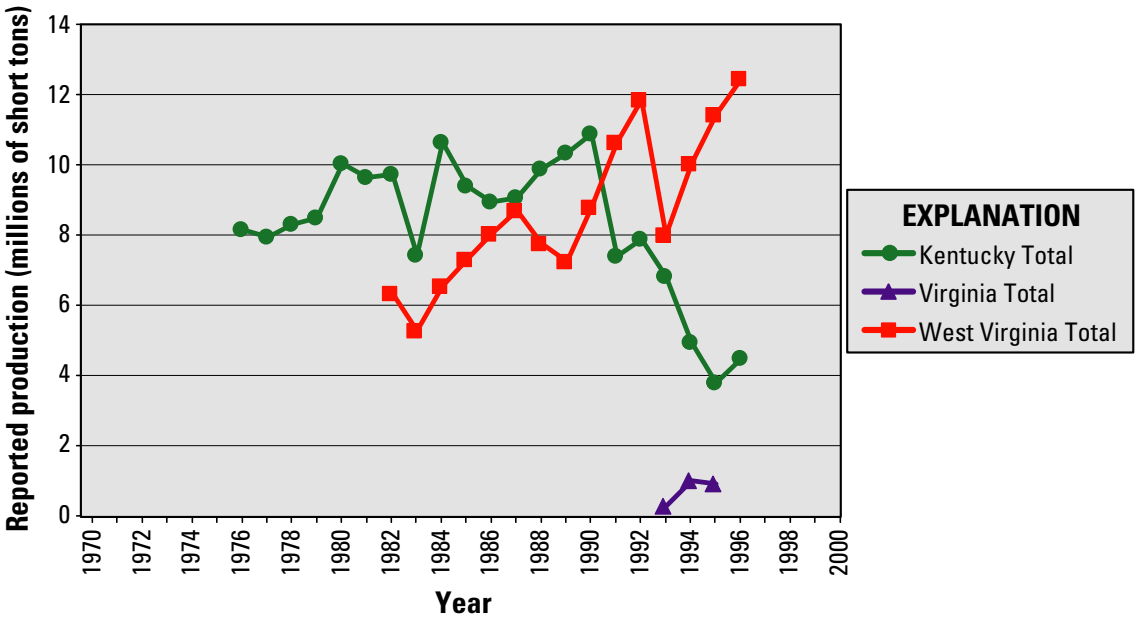


Figure 19. Graph showing annual coal production of the Winifrede/Hazard coal zone, by State (in millions of short tons). Data are from Appendix 9 (table A9–3). Source: Appendix 7.

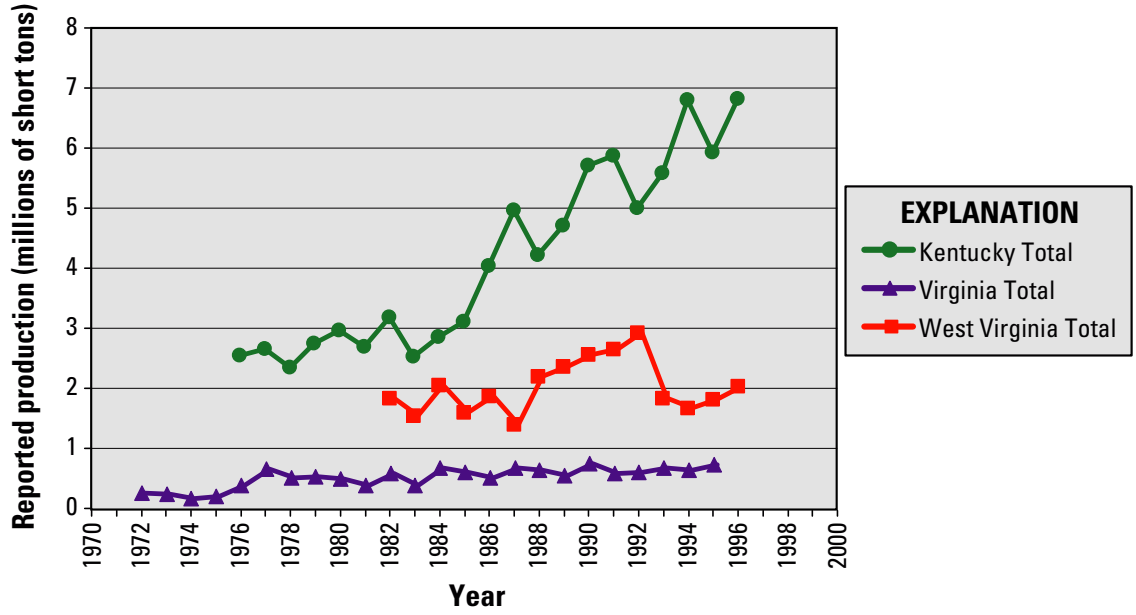


Figure 20. Graph showing annual coal production of the Williamson/Amburgy coal zone, by State (in millions of short tons). Data are from Appendix 9 (table A9–4). Source: Appendix 7.

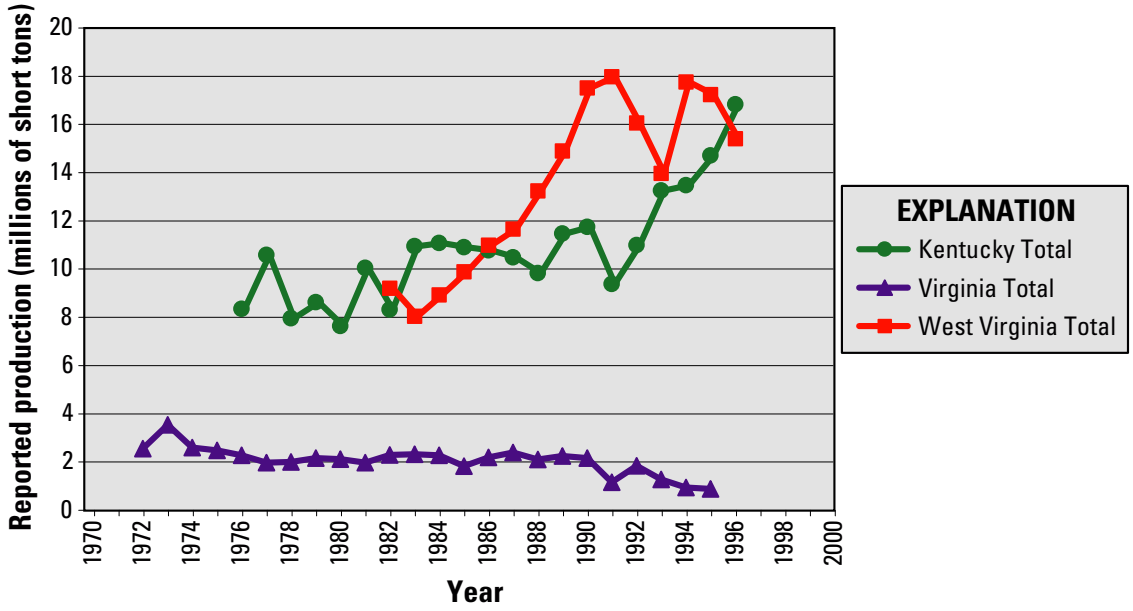


Figure 21. Graph showing annual coal production of the Campbell Creek/Upper Elkhorn No. 3 coal zone, by State (in millions of short tons). Data are from Appendix 9 (table A9–5). Source: Appendix 7.

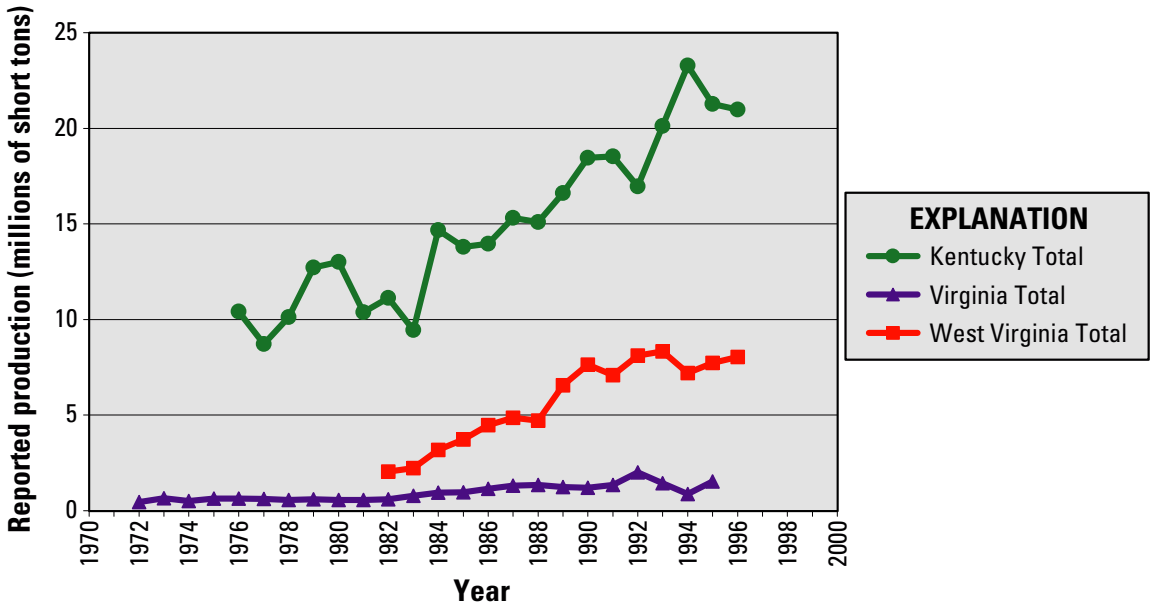


Figure 22. Graph showing annual coal production of the Upper Elkhorn Nos. 1 and 2/Powellton coal zone, by State (in millions of short tons). Data are from Appendix 9 (table A9–6). Source: Appendix 7.

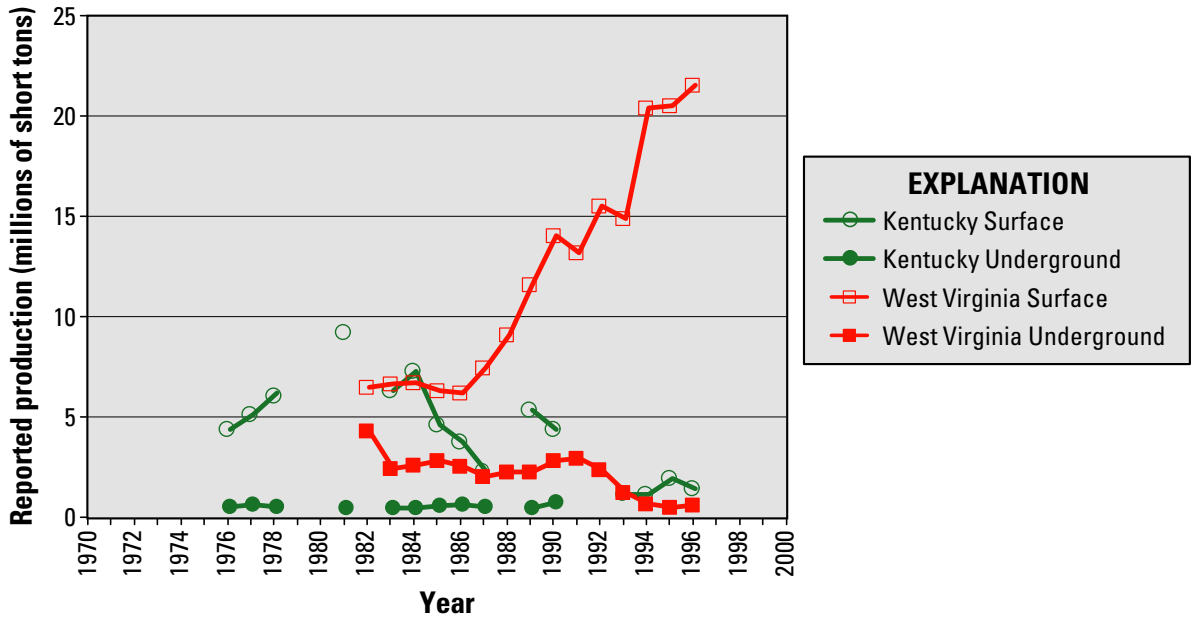


Figure 23. Graph showing annual coal production, by State and by mine type, of the No. 5 Block coal zone in West Virginia and eastern Kentucky (in millions of short tons). Data are from Appendix 9 (table A9–1). Source: Appendix 7.

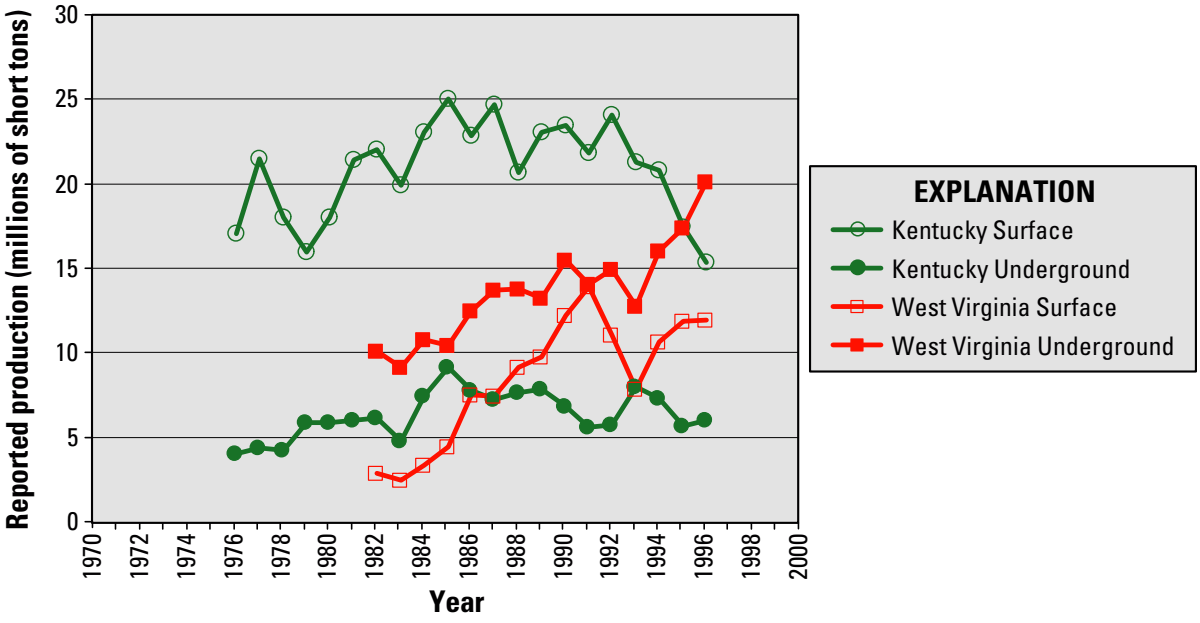


Figure 24. Graph showing annual coal production, by State and by mine type, of the Stockton and Coalburg coal zone in West Virginia and eastern Kentucky (in millions of short tons). Data are from Appendix 9 (table A9–2). Source: Appendix 7.

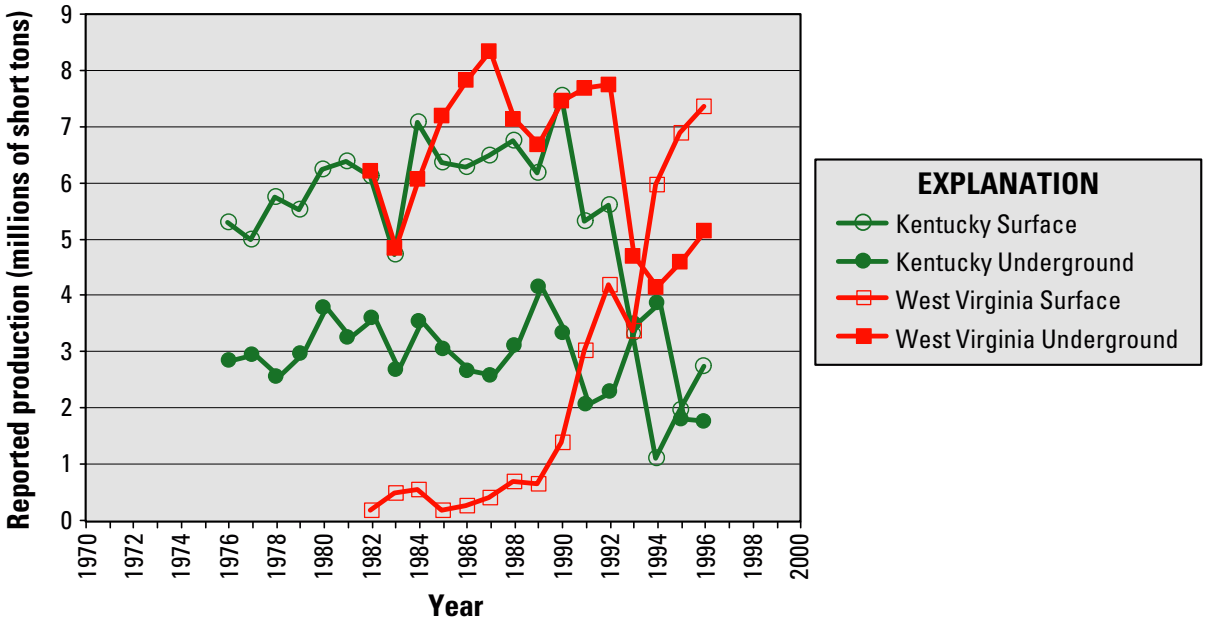


Figure 25. Graph showing annual coal production, by State and by mine type, of the Winifrede/Hazard coal zone in West Virginia and eastern Kentucky (in millions of short tons). Data are from Appendix 9 (table A9–3). Source: Appendix 7.

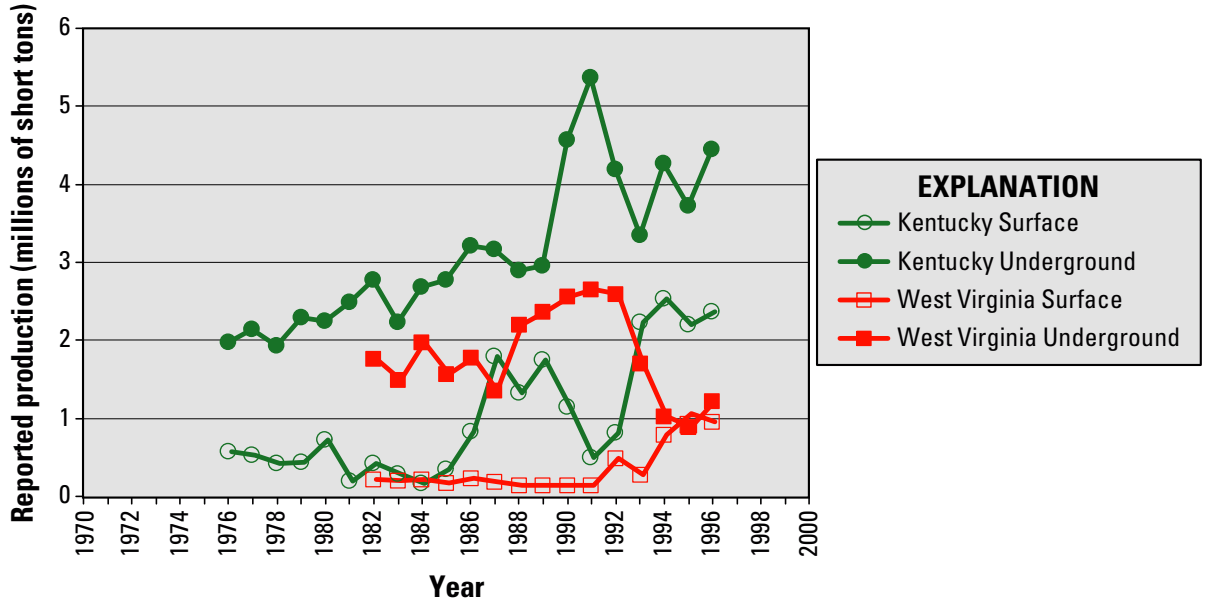


Figure 26. Graph showing annual coal production, by State and by mine type, of the Williamson/Amburgy coal zone in West Virginia and eastern Kentucky (in millions of short tons). Data are from Appendix 9 (table A9–4). Source: Appendix 7.

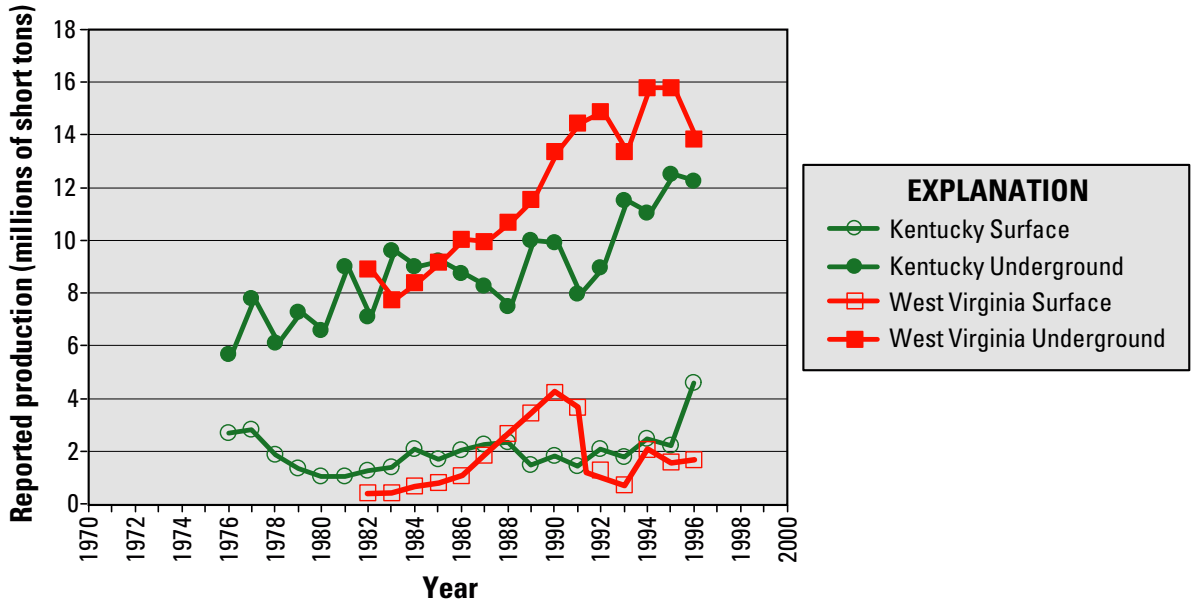


Figure 27. Graph showing annual coal production, by State and by mine type, of the Campbell Creek/Upper Elkhorn No. 3 coal zone in West Virginia and eastern Kentucky (in millions of short tons). Data are from Appendix 9 (table A9–5). Source: Appendix 7.

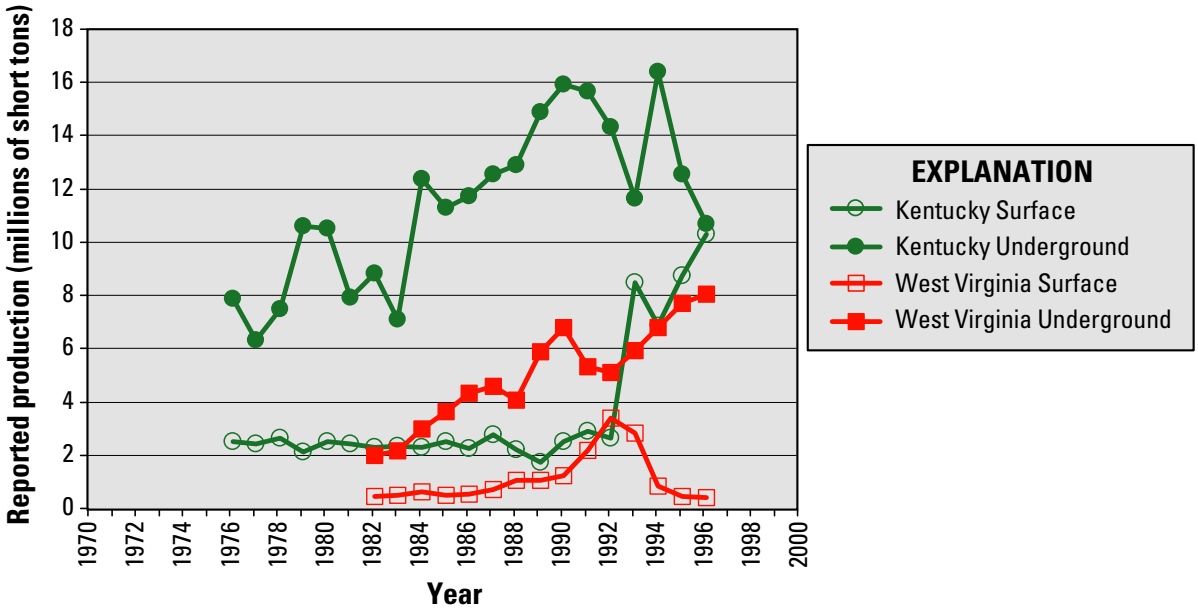


Figure 28. Graph showing annual coal production, by State and by mine type, of the Upper Elkhorn Nos. 1 and 2/Powellton coal zone in West Virginia and eastern Kentucky (in millions of short tons). Data are from Appendix 9 (table A9–6). Source: Appendix 7.

Middle Kittanning and Lower Kittanning in southern West Virginia (Appendix 2, table A2–1). Coal beds stratigraphically below the No. 5 Block also were misidentified by the mining industry. The coal-bed and coal-zone names used by the mining industry that are believed to be stratigraphically equivalent in West Virginia are listed for each coal zone in Appendix 2.

Many of the coal-bed correlations used in this chapter are different from the coal-bed correlations used by the former U.S. Bureau of Mines (USBM). The former USBM designated a four-digit numerical bed code for each coal bed name recognized in the Appalachian Basin; the same code was assigned to several coal-bed names where these coal beds were interpreted to be correlative (see table F–1 on p. 487–527 in Thomson and York, 1975). These USBM codes are still assigned to coal beds in reports by mine operators to the Energy Information Administration (EIA) on Form EIA-7A. Tabulations of coal-bed and coal-zone production reported by the Energy Information Administration are based on these correlations.

All of the problems inherent in correlating these units and grouping the coal beds into coal zones are not resolved in this report; however, these preliminary interpretations and references to the pertinent literature should significantly assist those interested in additional information on the geology and resources of these coal zones.

RESOURCES OF THE SIX COAL ZONES

Identified resources are defined as the total of measured plus indicated plus inferred coal resources greater than 14 in (1.17 ft) thick as specified by Wood and others (1983). The identified resources compiled for this report are from the USCOAL database (U.S. Geological Survey, 1997). The USCOAL database contains estimated identified coal resources, either original or remaining, as they were presented in the source documents. The source documents were published in various years from 1940 through 1963 (see 'year' in Appendix 3) and present resource data estimates made in various years from 1900 through 1959 (see 'base year' in Appendix 3). The most recent multistate resource estimate dates to January 1, 1974 (Averitt, 1975). Production data have not been incorporated in the USCOAL database to bring remaining resource estimates up to date. Resource estimates from the USCOAL database were recompiled for each coal zone using the revised correlations (fig. 1) and equivalent coal-bed names (Appendix 1). The USCOAL database was searched for all possible coal-bed names for each coal zone (Appendix 1) in eastern Kentucky, West Virginia, Virginia, and Tennessee. The data set used to compile the resource estimates for the six coal zones is found in Appendix 3.

Identified coal resources are summarized for each coal zone (table 2). For each of the six coal zones, Appendix 4 organizes data by designated coal-bed or coal-zone name; Appendix 5 organizes the data by county. Also, for each coal zone, the geographic distribution and amount of coal resources on a county basis are illustrated in figures 5 through 10. These are generalized maps that show counties where the presence of coal is reported for each coal zone. Identified coal resources compiled by State and reliability class for each coal zone (Appendix 6) are illustrated in figures 11 through 16. The total of measured plus indicated coal resources greater than 28 in (2.33 ft) thick, which is the part of the resources that is more likely to be economically recoverable, is calculated for each coal zone (Appendix 6) and summarized in table 2.

Underground coal production in the central Appalachian Basin coal region is almost always from coal greater than 28 in (2.33 ft) thick. The generally increasing production trends of the six coal zones suggest that a significant part of the remaining identified resource greater than 28 in (2.33 ft) thick may have been mined during the 37 years from 1959 (the most recent base year for the estimated resource data in Appendix 3) through 1996 (the most recent year of production data compiled in this report; see Appendix 7).

MINING HISTORY OF THE SIX COAL ZONES

The coal fields of the central Appalachian Basin coal region historically have been less accessible than those of the northern Appalachian Basin because of the dissected topography, lack of navigable rivers, and few large population centers. The locus of coal production in the Appalachian Basin has shifted over time from the northern to the central Appalachian Basin coal region (Milici, 1999; also see Chapter A, Appendix 1, this report) due to an increase in demand for low-sulfur coal. Coal-production data has been compiled by county for each decade between 1899 and 1996 (Milici, 1999). The maximum total coal production was attained in 30 of the 54 counties in the central Appalachian Basin coal region between 1980 and 1996 (fig. 3, table 1). Thus, each of the six coal zones, which are located in the central Appalachian Basin coal region, probably had lower annual production prior to the 1980's, which is earlier than the dates for the detailed production data presented in this report.

Historic records of annual coal production by coal bed in the central Appalachian Basin coal region prior to the 1970's are difficult to find, retrieve, and correlate and were not compiled for this report. Annual coal-production records starting in the 1970's, compiled for this chapter

(Appendix 7), were obtained from several sources, include varying degrees of detail, and cover different periods of record (Appendix 8).

Annual production data for each coal zone, by State (figs. 17–22 and Appendix 9), were compiled from State coal-bed production data (Appendix 7) based on revised stratigraphic correlations (fig. 1) and correlative coal-bed names (Appendixes 1 and 2). Coal-zone production in 1982 and 1996 is summarized in table 2. Annual production by mine type in eastern Kentucky and West Virginia for each coal zone is shown in figures 23 through 28 and this data may be found in Appendix 9.

GEOCHEMISTRY OF THE SIX COAL ZONES

Coal geochemistry data are drawn from the U.S. Geological Survey Coal Quality (COALQUAL) database (Bragg and others, 1998). The coal samples in COALQUAL were collected and analyzed in the late 1970's and early 1980's. Each coal sample in the database represents the complete coal-bed thickness at the sample location and is either a channel sample (collected from a coal face exposure), a drill-core sample (a representative split of a drill core), or a composite sample (calculated from two or more samples collected sequentially from the coal bed and weighted by the thickness of each sample). Bragg and others (1998) reported trace-element data that were below the detection limit by multiplying the detection limit by 0.7 in order to represent the possible presence of trace elements at low concentrations that could not be detected by the analytical methods. Data below the detection limit and data collected by some analytical methods that have interference when high concentrations of specific elements are present are considered qualified data and should be used with extreme caution when more than 10 percent of the data is qualified. The coal-quality sample set for each coal zone is limited in number and sample distribution because it is biased toward mine locations of the 1970's and 1980's and does not necessarily represent the lateral extent of the coal zone. Coal samples in COALQUAL from States in the central Appalachian Basin coal region were correlated based on the sample's designated coal-bed name according to coal-zone correlations (fig. 1) and equivalent coal-bed names (Appendix 1) used in this report.

COALQUAL coal geochemistry data for coal-bed samples in the six coal zones may be found in Appendix 10. Summary data (mean, minimum, and maximum values; standard deviation; and number of samples) for coal-zone geochemistry are presented by State and county for ash yield (Appendix 11), sulfur content (Appendix 12), gross calorific value (Appendix 13), sulfur-dioxide (SO_2) emission levels (Appendix 14), arsenic content (Appendix 15), and mercury content (Appendix 16). The mean and standard deviation for each coal-quality parameter for each coal zone are summarized in table 2.

High outlier values (herein defined as greater than the mean plus three times the standard deviation) were not discarded from the sample suite for sulfur, arsenic, or mercury content, or for gross calorific value, for any of the six coal zones discussed in this chapter. This is in contrast to the coal-quality data discussed in Chapters C through H of this report for the six coal beds that were assessed. For those coal beds, any sample that had a high outlier value for those parameters, or for any of the other hazardous air pollutant elements (HAP's) was discarded and the mean, maximum, and standard deviations were recalculated for each parameter. Thus, the mean, maximum, and standard deviation values for sulfur, gross calorific value, sulfur-dioxide emissions, arsenic, and mercury reported in table 2 and Appendixes 11 through 16 are not directly comparable to those reported for the six assessed coal beds in Chapters C through H.

The ranges for ash yield (as-received whole-coal basis) are classified as low (<8 weight percent), medium (8 to 15 percent), and high (>15 percent). For sulfur content (as-received whole-coal basis) the categories are low (≤1 percent), medium (>1 to <3 percent), and high (≥3 percent). Both classifications are specified in Wood and others (1983). Gross calorific value is reported on an as-received whole-coal basis. Sulfur-dioxide (SO_2) emissions of less than 1.2 lbs SO_2 per million Btu are considered to be compliant with the Clean Air Act Amendments of 1990 (Public Law 101-549). Arsenic and mercury contents, which were determined on a remnant-moisture whole-coal basis, are compared to the mean values for Appalachian Basin coal (35 ppm (parts per million) for arsenic and 0.21 ppm for mercury) as reported in Finkelman and others (1994), and mean values for U.S. coal (24 ppm for arsenic and 0.17 ppm for mercury) as reported in Finkelman (1993).

COALBED METHANE OF THE SIX COAL ZONES

The coalbed methane content and potential for the six coal zones are mostly unstudied. The coal zones are generally located in dissected terrains. In addition, many of the coal beds are above drainage and thus have lower hydrostatic pressures than are needed to retain significant quantities of methane within the coal beds.

Total coalbed methane content (the sum of lost, desorbed, and residual gas) was determined on 33 virgin coal samples from exploration cores by Diamond and Levine (1981) and Diamond and others (1986) from four of the six coal zones (Stockton and Coalburg, Williamson/Amburgy, Campbell Creek/Upper Elkhorn No. 3, and Upper Elkhorn Nos. 1 and 2/Powellton) discussed in this report. Masemore and others (1996) suggest ranges to categorize coalbed

methane content as follows: very low, less than 50 ft^3/ton; low, 50 to 99 ft^3/ton; medium, 100 to 299 ft^3/ton; high, 300 to 499 ft^3/ton; and very high, 500 to 709 ft^3/ton (see table 1–5 in Masemore and others, 1996). Data for methane emissions from coal mines are also limited. Methane emissions measured in nine mines located in the two lower coal zones, the Campbell Creek/Upper Elkhorn No. 3 and the Upper Elkhorn Nos. 1 and 2/Powellton, are reported by Grau and LaScola (1984).

Adams (1984), Kelafant and Boyer (1988), and Masemore and others (1996) all conclude (citing data by Diamond and Levine (1981) and Diamond and others (1986)) that the area with the greatest estimated coalbed methane resource is on the eastern side of the central Appalachian Basin coal region in coal beds that are stratigraphically below the six coal zones discussed in this report. Although coalbed methane production in the central Appalachian Basin coal region has increased markedly from 1990 to 1996, this production is almost entirely from the southwest Virginia coal field (Stevens and others, 1996; Lyons, 1998; Nolde and Spears, 1998; Virginia Center for Coal and Energy Research, 1999), is primarily from coal beds below the six coal zones discussed in this chapter, and corroborates the earlier coalbed methane resource potential studies.

ACKNOWLEDGMENTS

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THE NO. 5 BLOCK COAL ZONE

STRATIGRAPHIC POSITION AND NAMES OF CORRELATIVE COAL BEDS

The No. 5 Block coal zone is in the lower part of the Allegheny Group (as used in this report) (fig. 1). In eastern Kentucky, the No. 5 Block coal zone is equivalent to the Richardson and Skyline coal zones and is in the lower part of the Princess Formation of Chesnut (1992) in the upper part of the Breathitt Group as used by Chesnut (1992) (Rice and Hiett, 1994; Chesnut, 1997; Donald R. Chesnut, Jr., and Cortland F. Eble, KGS, written commun., 1999) (fig. 1). In eastern Kentucky, the Richardson coal zone is included in the No. 5 Block coal zone in this report, although recent work suggests the Richardson coal zone may be equivalent to the stratigraphically lower Little No. 5 Block (Donald R. Chesnut, Jr., and Cortland F. Eble, written commun., 1999). In southern West Virginia, the zone is in the Charleston Sandstone between the No. 6 Block coal bed (above) and the Little No. 5 Block and Stockton "A" coal beds (below) (Blake, 1992; Martino and others, 1998). Correlative coal-bed names and their geographic distribution are listed in Appendix 1 (table A1–1).

In southern West Virginia, the No. 5 Block coal zone historically has been correlated with the Lower Kittanning coal bed of northern West Virginia, Pennsylvania, and Ohio (Headlee and Nolting, 1940). More recent palynology studies by Kosanke (1988) and Eble (1994) place the Lower Kittanning coal bed somewhat higher in the stratigraphic section at the same horizon as the No. 6 Block coal bed and above the No. 5 Block coal bed. The No. 5 Block coal zone probably does not have a significant correlative coal bed in the northern Appalachian Basin coal region (Eble, 1994); however, the coal zone has been variously interpreted to be above the Clarion coal bed (Headlee and Nolting, 1940; Hower and others, 1994), equivalent to the Clarion coal bed (Rice, Kosanke, and Henry, 1994), or below the Clarion coal bed and above the Lower Mercer coal bed in Pennsylvania and Ohio (Blake, 1992; Eble, 1994). Although the Clarion coal bed (and possibly the Brookville coal bed below it) in Ohio and Pennsylvania may be equivalent to coal in the No. 5 Block coal zone, this correlation is so tenuous that data for the Clarion and Brookville coal beds were not included in this report.

Confusion over the stratigraphic position and the correlation of the No. 5 Block coal zone from the central to the northern Appalachian Basin coal region persists in the nomenclature used by the coal mining industry in West Virginia (Appendix 2, table A2–1). The mining industry uses several other coal-bed names in some counties in southern West Virginia (such as the Mahoning, Upper

Freeport, Lower Freeport, Upper Kittanning Rider, Middle Kittanning, and Lower Kittanning coal beds) for coal that is interpreted to be in the No. 5 Block coal zone (Appendix 2, table A2–1). The former U.S. Bureau of Mines (USBM) bed code 0084, which is used by mine operators to report coal production to the Energy Information Administration on Form EIA-7A, combines No. 5 Block coal bed and Lower Kittanning coal bed production data (see table 8 in Energy Information Administration, 1997).

LOCATION AND EXTENT

The probable original minable extent of the No. 5 Block coal zone is represented approximately by published maps of the Skyline coal zone and correlative coal beds in eastern Kentucky (see plate 14 in Huddle and others, 1963), and by the Lower Kittanning and No. 5 Block coal beds in West Virginia (see figure 21 on p. 45 in Headlee and Nolting, 1940). Headlee and Nolting (1940) estimated the area of minable coal in the Lower Kittanning and No. 5 Block coal beds to be 2,640 mi^2. However, later work by Kosanke (1988) and Eble (1994) interpreted the Lower Kittanning coal bed of northern West Virginia to be stratigraphically higher than the No. 5 Block coal bed of southern West Virginia (fig. 1). Thus, approximately one third of the area of the Lower Kittanning and No. 5 Block coal beds that is located in northern West Virginia (see figure 21 on p. 45 in Headlee and Nolting, 1940) would not be included in a map representing the extent of the No. 5 Block coal zone.

COAL-BED DESCRIPTION

Descriptions of coal beds equivalent to the No. 5 Block coal zone in eastern Kentucky are given by Huddle and others (1963) and Hower and others (1994), and in West Virginia are given by Headlee and Nolting (1940) and Staub and Richards (1993). The No. 5 Block coal bed is typically about 5 ft thick and consists of multiple benches. The thickness of the coal benches is locally variable and individual benches may be limited in extent. The coal is characterized by its dull appearance, blocky fracture, and low ash yield. Thick coal benches usually consist of bright, high-ash coal at the base with dull, low-ash coal above (Staub and Richards, 1993). In West Virginia, the No. 5 Block coal zone is often equivalent to two beds, the Lower No. 5 Block and Upper No. 5 Block coal beds. In the Kanawha Valley region, the Lower No. 5 Block coal bed consists of as many as four benches, including a leader coal and a rider coal; the Upper No. 5 Block coal bed may consist of as many as three benches (Staub and Richards, 1993).

COAL RESOURCES

Identified coal resources for the No. 5 Block coal zone (Appendix 3) were compiled from the USCOAL database (U.S. Geological Survey, 1997). The No. 5 Block coal-zone resources are reported from nine coal beds in eastern Kentucky and West Virginia (Appendix 4, table A4–1). Equivalent coal beds with large resources in the coal zone are the No. 5 Block coal bed (60 percent of the resource) in southern West Virginia, and the Lower Kittanning coal bed (16 percent) in Kanawha County, W. Va. The amount of No. 5 Block coal-zone resource in each county in the central Appalachian Basin coal region (Appendix 5, table A5–1) is shown in figure 5. Four counties in West Virginia (Braxton, Clay, Kanawha, and Nicholas) contain more than 50 percent of the resource, and each county had more than 800 million short tons of identified No. 5 Block coal-zone resources. The coal zone is estimated to have a total of 7.5 billion short tons (Appendix 6, table A6–1) that are almost entirely in West Virginia (fig. 11). In eastern Kentucky, 32 percent of the No. 5 Block coal-zone resources are greater than 28 in (2.33 ft) thick in the measured and indicated reliability categories (Appendix 6, table A6–1). In West Virginia, the resource is poorly constrained as a result of unclassified thickness and reliability information for 97 percent of the No. 5 Block coal-zone resource (Appendix 6, table A6–1).

MINING HISTORY

In West Virginia, descriptions of early (pre-1940) production from the No. 5 Block (or Lower Kittanning) coal beds is found in Headlee and Nolting (1940) for Nicholas, Clay, Fayette, Kanawha, Logan, Lincoln, and Wayne Counties (see fig. 3 for county locations). In Kentucky, the Richardson coal zone was locally mined out in the Licking River reserve district by 1963, and much of the thick coal was mined out in the Princess and Hazard reserve districts (Huddle and others, 1963) (see fig. 4 for reserve district locations). More recently, Hower and others (1994) pointed out that the No. 5 Block coal was being mined out in mountain tops in the Princess and Big Sandy reserve districts (fig. 4).

Recent production data by coal zone and State are available sporadically from 1976 on in eastern Kentucky and from 1982 on in West Virginia (Appendix 9, table A9–1) and are shown in figure 17. Annual production of the No. 5 Block coal zone exceeded 10 million short tons in the central Appalachian Basin coal region from 1982 through 1996. Cumulative production from the No. 5 Block coal zone in the central Appalachian Basin coal region from 1982 through 1996 was 250 million short tons, of which 210 million short tons (84 percent) was from West Virginia. For the

ten-year period from 1986 through 1995, mean annual production was 2.9 million short tons in Kentucky and 15 million short tons in West Virginia. This coal zone represented 2 percent of the total coal production in eastern Kentucky and 10 percent of the total coal production in West Virginia as reported by the Energy Information Administration (see table 1 in Energy Information Administration, 1995, 1996, 1997, 1998, 2000).

Trends in No. 5 Block coal-zone production by State and by mine type are shown in figure 23. Total production from the No. 5 Block coal zone increased overall by 8 million short tons from 1982 through 1996. The increase reflects a nearly three-fold increase in surface mining, mostly by mountain-top-removal mining, in southern West Virginia (Appendix 9, table A9–1). Production by surface mining methods exceeded underground production from 1982 through 1996. In the 1990's, surface production rose to 99 percent of the total No. 5 Block coal-zone production.

The locus of production of the No. 5 Block coal zone is Boone, Kanawha, Logan, and Clay Counties (fig. 3) in southern West Virginia (Appendix 7). These four counties yielded 60 to 80 percent of the coal zone's production in West Virginia and 33 to 75 percent of its total production in the central Appalachian Basin coal region from 1982 through 1996. In eastern Kentucky, over half of the coal zone's production in 1990 was from Martin County (fig. 3) in the Big Sandy reserve district (fig. 4) (Hower and others, 1994).

GEOCHEMISTRY

In the No. 5 Block coal zone, 93 complete coal-bed samples from 48 locations in eastern Kentucky and 45 locations in West Virginia were analyzed for ash yield, sulfur content, gross calorific value, and arsenic and mercury contents. The apparent rank and sulfur-dioxide (SO_2) emission values were calculated from analytical results. The data were taken from the USGS's COALQUAL database (Bragg and others, 1998) (Appendix 10). The coal zone is dominated by medium and low ash yield (mean is 11.8±5.5 weight percent, range is 2.7 to 31.5 weight percent, as-received whole-coal basis) (Appendix 11, table A11–1) and medium and low sulfur content (mean is 1.15±0.89 weight percent, range is 0.40 to 4.87 weight percent, as-received whole-coal basis) (Appendix 12, table A12–1). The mean sulfur content is apparently higher in eastern Kentucky (1.42±1.12 weight percent, range is 0.41 to 4.87 weight percent) than in West Virginia (0.86±0.34, range is 0.40 to 2.10 percent), although the large scatter in the data suggests that this difference may not be significant (Appendix 12, table A12–1). Further data for ash yield, sulfur content, petrology, and palynology for the No. 5 Block coal zone can be found in Staub and Richards (1993) and Hower and others (1994).

The apparent rank of the No. 5 Block coal zone generally is high volatile B and A bituminous. Gross calorific values range from a minimum of 9,270 Btu/lb to a maximum of 14,260 Btu/lb, with a mean value of 12,150±1,050 Btu/lb (as-received whole-coal basis) (Appendix 13, table A13–1). The calculated sulfur-dioxide (SO_2) emission levels have a minimum value below compliance (0.76 lbs/million Btu); however, the mean value is above compliance (1.93±1.54 lbs/million Btu) (Appendix 14, table A14–1).

The mean arsenic content (remnant-moisture whole-coal basis) of the No. 5 Block coal zone is 14±24 ppm (Appendix 15, table A15–1), which is less than the mean for the Appalachian Basin (35 ppm) reported in Finkelman and others (1994) and less than the mean arsenic content for U.S. coal (24 ppm) reported in Finkelman (1993). The mean arsenic content appears to be higher in eastern Kentucky (19±31) than in West Virginia (9.0±11 ppm), although the large scatter in the data suggests that this difference may not be significant (Appendix 15, table A15–1). The mean mercury content (remnant-moisture whole-coal basis) of 0.18±0.18 ppm (Appendix 16, table A16–1) is similar to the means for the Appalachian Basin (0.21 ppm) (Finkelman and others, 1994) and for U.S. coal (0.17 ppm) (Finkelman, 1993). The mean mercury content appears to be similar in eastern Kentucky (0.20±0.23 ppm) and West Virginia (0.16±0.11 ppm) (Appendix 16, table A16–1).

STOCKTON AND COALBURG COAL ZONE

STRATIGRAPHIC POSITION AND NAMES OF CORRELATIVE COAL BEDS

The Stockton and Coalburg coal zone is in the upper part of the Pottsville Group (as used in this report). The Stockton and Coalburg coal zone is discussed as a single coal zone because the Stockton and Coalburg coal beds coalesce with multiple benches in some places in Boone and Kanawha Counties, W. Va. (fig. 3) (Blake, 1998). In eastern Kentucky, the coal zone is equivalent to the Broas and Peach Orchard coal zones that are in the upper part of the Four Corners Formation of Chesnut (1992), in the upper part of the Breathitt Group as used by Chesnut (1992), between the Stoney Fork Member (above) and the Arnett Member (below) (Chesnut, 1992, 1996, 1997; Rice and Hiett, 1994) (fig. 1). The upper part of the Broas coal zone is included in the Stockton and Coalburg coal zone in this report, although recent work indicates that it should be placed above the Stoney Fork Member in the stratigraphically higher Princess Formation of Chesnut (1992)

(Chesnut, 1997; Rice and Hiett, 1994). On the Cumberland overthrust sheet, southeast of the Pine Mountain fault in eastern Kentucky, the coal zone is equivalent to the Black Mountain coal zone and the High Splint coal zone (Chesnut, 1997) (fig. 1). In southern West Virginia, the Stockton and Coalburg coal zone is in the Kanawha Formation between the informally named Kanawha black flint of White (1891) (above) and the Arnett Member (below) (Blake, 1992, 1998; Rice, Hiett, and Koozmin, 1994) (fig. 1). In Virginia, the Stockton and Coalburg coal zone is equivalent to the No. 13 coal bed at the base of the Harlan Formation and the underlying High Splint coal bed and No. 12 coal bed at the top of the Wise Formation (Nolde, 1994a,b). In Tennessee, the Hazard No. 9 and the Hindman coal beds cover a small area (tens of acres) near the tops of a few mountains and may correlate to the Coalburg coal (Charles L. Rice, USGS (retired), oral commun., 1999). Correlative coal-bed names and their geographic distribution are listed for the Stockton and Coalburg coal zones in Appendix 1 (tables A1–2 and A1–3).

The Stockton coal zone of southern West Virginia historically was correlated with the Lower Mercer coal bed in Pennsylvania, Ohio, and northern West Virginia (also called the No. 3 coal bed in Ohio) and it was placed in the upper part of the Pottsville Group (Headlee and Nolting, 1940; Tom L. Phillips, University of Illinois (retired) and Russell A. Peppers, Illinois State Geological Survey (retired), written commun., 1983). Because these correlations are very tenuous and the Stockton and Coalburg coal zone probably does not have a significant correlative coal bed in the northern Appalachian Basin coal region (Eble, 1994), only the central Appalachian Basin coal region correlative coal beds will be discussed in this report.

There is also confusion over the stratigraphic position and the correlation of beds within the Stockton and Coalburg coal zone in the nomenclature used by the coal mining industry. The mining industry uses several other coal-bed names in some counties in southern West Virginia (such as Middle Kittanning, Lower Kittanning, and Winifrede coal beds) for coal that is interpreted to be in the Stockton and Coalburg coal zone (Appendix 2, tables A2–2 and A2–3). Additionally, the former U.S. Bureau of Mines (USBM) bed code 0111, used by mine operators to report coal production to the Energy Information Administration on Form EIA-7A, combines coal production data for the Hazard No. 5A coal bed in eastern Kentucky with the Coalburg coal in West Virginia as noted on table 8 in Energy Information Administration (1997), although recent work places the Hazard No. 5A coal bed in the stratigraphically lower Winifrede/Hazard coal zone (Chesnut, 1997) (Appendix 1, table A1–4).

LOCATION AND EXTENT

The probable original minable extent of the Stockton and Coalburg coal zone is represented approximately by published maps of the Francis coal zone and correlative coal beds and the Hazard No. 7 coal zone and correlative coal beds in eastern Kentucky (see plates 12 and 13 in Huddle and others, 1963), the Stockton-Lewiston and Coalburg coal beds in West Virginia (see figures 24 and 25 on p. 54 and 59 in Headlee and Nolting, 1940), and the Harlan Formation in Virginia (see figure 29 in Nolde, 1994a). Headlee and Nolting (1940) estimated the area of minable coal in the Stockton-Lewiston and Coalburg coal beds to be 1,350 and 875 mi^2, respectively. In Virginia, the No. 13 coal bed is almost certainly less extensive than the encompassing Harlan Formation.

COAL-BED DESCRIPTION

Descriptions of the coal in the Stockton and Coalburg coal zone in eastern Kentucky are found in Huddle and others (1963) and Hower and others (1996). In West Virginia, descriptions are found in Headlee and Nolting (1940), Pierce and others (1993), Blake (1998), and Martino and others (1998). The Stockton and Coalburg coal beds in West Virginia, and equivalent coal beds in eastern Kentucky, are typically thick over wide areas; each bed averages about 4 to 5 ft and has a range of about 2 to 9 ft. Each coal bed usually is found as more than one bench. The coal generally has a dull appearance and hard blocky nature. The coal is characterized as a splint coal with numerous impure coal and clastic partings and high inertinite and liptinite contents. The High Splint coal bed in Virginia (fig. 1) is 4 to 5 ft thick where it is mined (Lovett, 1998).

COAL RESOURCES

Identified coal resources for the Stockton and Coalburg coal zone (Appendix 3) were compiled from the USCOAL database (U.S. Geological Survey, 1997). The Stockton and Coalburg coal-zone resources are reported from 16 coal beds in eastern Kentucky, West Virginia, and Virginia (Appendix 4, table A4–2). Coal beds with large resources in the coal zone are the Stockton-Lewiston (old name) and the Coalburg, both in southern West Virginia, with 38 and 26 percent, respectively, of the coal zone's resource. The amount of Stockton and Coalburg coal-zone resources in each county in the central Appalachian Basin coal region

(Appendix 5, table A5–2) is shown in figure 6. Five counties in southern West Virginia (Boone, Clay, Kanawha, Nicholas, and Webster) (fig. 3) contain almost 50 percent of the resource, and each county had more than 800 million short tons of identified Stockton and Coalburg coal-zone resources. The coal zone is estimated to have a total of 12 billion short tons (Appendix 6, table A6–2) that are almost entirely in eastern Kentucky and West Virginia with 4.0 and 7.9 billion short tons, respectively (fig. 12). Less than one percent of the estimated coal resource is in Virginia and Tennessee (Appendix 4, table A4–2). In eastern Kentucky, 58 percent of the Stockton and Coalburg coal-zone resources are greater than 28 in (2.33 ft) thick in the measured and indicated reliability categories (Appendix 6, table A6–2). Thickness and reliability of 87 percent of the Stockton and Coalburg coal resources in West Virginia were unclassified (Appendix 6, table A6–2).

MINING HISTORY

In West Virginia, early (pre-1940) production data for the Stockton coal zone is found in Headlee and Nolting (1940) for Kanawha, Lincoln, and Wayne Counties (fig. 3). In Kentucky, the Torchlight coal zone and the Princess No. 4 and Hindman coal beds (in the Broas coal zone) were mined locally before 1963 (Huddle and others, 1963). In West Virginia, early (pre-1940) production data for the Coalburg coal zone is found in Headlee and Nolting (1940) for Nicholas, Clay, Fayette, Kanawha, Boone, Logan, and Mingo Counties (fig. 3). Huddle and others (1963) also discuss production from the Princess No. 3 coal bed, Peach Orchard coal zone, Francis coal zone, and the High Splint coal bed (Peach Orchard coal zone) that were mined in various reserve districts of eastern Kentucky, including those on the Cumberland overthrust sheet, south of the Pine Mountain fault.

Recent production data by coal zone and State are available from 1976 on in eastern Kentucky, from 1982 on in West Virginia, and from 1972 on in Virginia, (Appendix 9, table A9–2) and are illustrated in figure 18. Annual production from the Stockton and Coalburg coal zone exceeded 35 million short tons in the central Appalachian Basin coal region from 1982 through 1996. Cumulative production from the Stockton and Coalburg coal zone in the central Appalachian Basin coal region from 1982 through 1996 was 770 million short tons, of which 430 million short tons (56 percent) was from eastern Kentucky and 330 million short tons (43 percent) was from West Virginia (Appendix 9, table A9–2). For the ten-year period from 1986 through 1995, mean annual production was 29 million short tons in Kentucky and 25 million short tons in West Virginia. This coal zone represented 24 percent of the total coal production in eastern Kentucky and 16 percent of the total coal production in West Virginia as reported by the Energy Information Administration (see table 1 in Energy Information Administration, 1995, 1996, 1997, 1998, 2000).

Trends in Stockton and Coalburg coal-zone production by State and by mine type are illustrated in figure 24. Total production of Stockton and Coalburg coal zone increased overall by 12 million short tons from 1982 through 1996. The increase reflects an increase in both Stockton and Coalburg coal production by both surface and underground mining methods in southern West Virginia (Appendix 9, table A9–2). Production amounts of the Stockton and Coalburg coal zone in the central Appalachian Basin coal region by surface and underground mining methods were nearly equal by 1996.

The locus of production of the Stockton and Coalburg coal zone is Logan and Mingo Counties in southern West Virginia (Appendix 7). These two counties yielded 45 to 62 percent of the coal zone's production in West Virginia and 14 to 37 percent of its production in the central Appalachian Basin coal region from 1982 through 1996. In Virginia, all production of the High Splint coal bed is from Wise County (Lovett, 1998).

GEOCHEMISTRY

In the Stockton and Coalburg coal zone, 206 complete coal-bed samples from 163 locations in eastern Kentucky, 42 locations in West Virginia, and 1 location in Virginia were analyzed for ash yield, sulfur content, gross calorific value, and arsenic and mercury contents. The apparent rank and sulfur-dioxide (SO_2) emission values were calculated from analytical results. The data were taken from the USGS's COALQUAL database (Bragg and others, 1998) (Appendix 10). The coal zone is dominated by medium and low ash yield (mean is 11.4±5.6 weight percent, range is 2.7 to 30.7 weight percent, as-received whole-coal basis) (Appendix 11, table A11–2) and medium and low sulfur content (mean is 1.26±0.98 weight percent, range is 0.40 to 5.50 weight percent, as-received whole-coal basis) (Appendix 12, table A12–2). The mean sulfur content appears to be higher in eastern Kentucky (1.38±1.05 weight percent, range is 0.40 to 5.50 weight percent) than in West Virginia (0.83±0.47 weight percent, range is 0.40 to 3.20 weight percent), although the large scatter in the data suggests that this difference may not be significant (Appendix 12, table A12–2). Further data for ash yield, sulfur content, petrology, and palynology for the Stockton and Coalburg coal zone can be found in Eble and Grady (1993), Pierce and others (1993), and Hower and others (1996).

The apparent rank of the Stockton and Coalburg coal zone generally is high volatile A and B bituminous. Gross calorific values range from a minimum of 8,700 Btu/lb to a

maximum of 14,330 Btu/lb, with a mean value of 12,340±1,020 Btu/lb (as-received whole-coal basis) (Appendix 13, table A13–2). The calculated sulfur-dioxide (SO_2) emission levels have a minimum value below compliance (0.70 lbs/million Btu) and a mean value above compliance (2.07±1.68 lbs/million Btu) (Appendix 14, table A14–2).

The mean arsenic content (remnant-moisture whole-coal basis) of the Stockton and Coalburg coal zone is 14±22 ppm (Appendix 15, table A15–2), which is less than the mean for the Appalachian Basin (35 ppm) reported in Finkelman and others (1994) and less than the mean arsenic content for U.S. coal (24 ppm) reported in Finkelman (1993). The mean arsenic content appears to be higher in eastern Kentucky (17±24 ppm) than in West Virginia (4.9±7.3 ppm), although the large scatter in the data suggests that this difference may not be significant (Appendix 15, table A15–2). The mean mercury content (remnant-moisture whole-coal basis) of 0.15±0.13 ppm (Appendix 16, table A16–2) is similar to the means for the Appalachian Basin (0.21 ppm) (Finkelman and others, 1994) and for U.S. coal (0.17 ppm) (Finkelman, 1993). The mean mercury content appears to be higher in eastern Kentucky (0.17±0.13 ppm) than in West Virginia (0.097±0.11 ppm), although the large scatter in the data suggests this difference may not be significant (Appendix 16, table A16–2).

COALBED METHANE

Coalbed methane content measured in one fresh core sample of Coalburg coal taken from a depth of 506 ft in Boone County, W. Va., was found to be very low at only 6 ft^3/t (Diamond and others, 1986; Masemore and others, 1996).

WINIFREDE/HAZARD COAL ZONE

STRATIGRAPHIC POSITION AND NAMES OF CORRELATIVE COAL BEDS

The Winifrede/Hazard coal zone is located in the upper part of the Pottsville Group (as used in this report). In Kentucky, the upper part of the coal zone is equivalent to the Hazard coal zone in the lower part of the Four Corners Formation of Chesnut (1992) in the upper part of the Breathitt Group as used by Chesnut (1992), between the Arnett Member (above) and the Magoffin Member (below), both as used by Chesnut (1992) (Rice and Hiett, 1994; Chesnut, 1996, 1997; Donald R. Chesnut, Jr., and Cortland F. Eble, KGS, written commun., 1999) (fig. 1). The lower part of the coal zone is equivalent to the Haddix coal zone, which in turn is equivalent to the Lower Winifrede and Lower Buffalo Creek coal beds of southern West Virginia (Chesnut, 1997; Donald R. Chesnut, Jr., and Cortland F. Eble, KGS, written commun., 1999). In southern West Virginia, the Winifrede coal zone is in the upper division of the Kanawha Formation as used by Blake (1998) between the Arnett Member (above) and the Winifrede Shale Member (below) (Blake and others, 1994; Blake, 1998) (fig. 1). In Virginia, the Morris coal zone, which is above the Reynolds Sandstone Member in the upper part of the Wise Formation, is included in the upper part of the Winifrede/Hazard coal zone (Nolde, 1994a; Rice and Hiett, 1994) (fig. 1). In Tennessee, west of the Cumberland overthrust sheet, the Braden Mountain, Pewee, and Red Ash coal beds, which are above the Fodderstack Sandstone Member in the upper part of the Redoak Mountain Formation, are included in the upper part of the Winifrede/Hazard coal zone (Rice, 1984) (fig. 1). Correlative coal bed names and their geographic distribution are listed in Appendix 1 (table A1–4).

There is confusion over the stratigraphic position and the correlation of the Winifrede/Hazard coal zone in the nomenclature used by the coal mining industry. In West Virginia, the mining industry uses the name Clarion coal bed in Braxton and Webster Counties for coal that is in the Winifrede/Hazard coal zone (Appendix 2, table A2–4). The former U.S. Bureau of Mines (USBM) bed code 0111, used by mine operators to report coal production to the Energy Information Administration on Form EIA-7A, combines production from the Coalburg coal in West Virginia with the Hazard No. 5A coal in eastern Kentucky (see table 8 in Energy Information Administration, 1997), although recent work places the Coalburg coal above the Winifrede/Hazard coal zone (Chesnut, 1997) (fig. 1; Appendix 1, table A1–3).

LOCATION AND EXTENT

The probable original minable extent of the Winifrede/Hazard coal zone is represented by published maps of the Hazard coal zone and correlative coal beds in eastern Kentucky (see plate 11 in Huddle and others, 1963), Winifrede and Buffalo Creek coal beds in West Virginia (see figures 27 and 26 on p. 64 and 63 in Headlee and Nolting, 1940), and the undivided Wise Formation of Atokan age in Virginia (see figure 28 in Nolde, 1994a). The map of the Hazard coal zone and correlative coal beds in eastern Kentucky (see plate 11 in Huddle and others, 1963) may be overly extensive because it includes the Princess No. 3 coal bed and the Peach Orchard coal zone, which later work interpreted to be stratigraphically higher, above the

Arnett Member and correlative to the Coalburg coal zone of West Virginia (Chesnut, 1997) (fig. 1). Headlee and Nolting (1940) estimated the area of minable coal in the Winifrede and Buffalo Creek coal beds to be 1,310 and 46 mi^2, respectively. Although the map of the Winifrede coal bed includes a small area of the Quakertown coal bed in Preston, Randolph, and Upshur Counties, W. Va. (see figure 27 on p. 64 in Headlee and Nolting, 1940), this correlation is tentative. The Quakertown coal bed is not included in the Winifrede/Hazard coal zone in this report (Appendix 1, table A1–4). In Virginia, the area of the undivided Wise Formation of Atokan age is almost certainly more extensive than the Morris coal bed within it.

COAL-BED DESCRIPTION

Descriptions of the Winifrede and Buffalo Creek coal beds in West Virginia are given by Headlee and Nolting (1940) and McColloch (1998). In eastern Kentucky, the Hazard and Prater coal zones and the Adele and Index coal beds are described by Huddle and others (1963) as bright banded to dull coal, and typically less than 4 ft thick but sometimes more than 5 ft thick. Partings are usually thin but in some areas the partings may be several to 30 ft thick between the main coal and a thin coal above or below. The Haddix coal zone thickness averages about 3 ft with a range of 1 to 5 ft, with shale partings 1 to 18 in thick. The Winifrede coal bed's thickness ranges from 2 to 12 ft with an average of about 4 ft, and it is usually a splint coal with single or multiple beds. The Buffalo Creek coal bed typically is partly splint coal, 4 to 7 ft thick, with an average thickness of about 5 ft. The Morris coal zone in Virginia is 3 to 3.5 ft thick (Lovett, 1998). In Tennessee, the Pewee coal bed is 3.5 to 7 ft thick with one to three thin partings, and the Red Ash coal bed is a hard, bright coal that is 3 to 5 ft thick (Zurowski and Miller, 1998).

COAL RESOURCES

Identified coal resources for the Winifrede/Hazard coal zone (Appendix 3) were compiled from the USCOAL database (U.S. Geological Survey, 1997). The Winifrede/Hazard coal-zone resources are reported from 13 coal beds in eastern Kentucky, West Virginia, Virginia, and Tennessee (Appendix 4, table A4–3). Coal beds with large resources in the coal zone are the Hazard in eastern Kentucky and the Winifrede in West Virginia with 22 and 51 percent, respectively, of the coal zone's resources. The amount of Winifrede/Hazard coal resource in each county in the central Appalachian Basin coal region (Appendix 5, table A5–3) is shown in figure 7. Two counties in eastern Kentucky (Breathitt and Perry) and two counties in West Virginia (Boone and Logan) contain almost 50 percent of the resource, and each county had more than 450 million short tons of identified Winifrede/Hazard coal-zone resources. The coal zone is estimated to have a total of 5.9 billion short tons (Appendix 6, table A6–3) that are almost entirely in eastern Kentucky and West Virginia,with 2.5 and 3.3 billion short tons, respectively (fig. 13). In eastern Kentucky, 52 percent of the Winifrede/Hazard coal-zone resources are greater than 28 in (2.33 ft) thick in the measured and indicated reliability categories (Appendix 6, table A6–3). In West Virginia, thickness and reliability of 80 percent of the Winifrede/Hazard coal-zone resource were unclassified (Appendix 6, table A6–3).

MINING HISTORY

In Kentucky before 1963, the Hazard, Prater, and Haddix coal zones and the Index, Adele, Colvin, and Red Springs coal beds were mined either commercially or locally for household use in various reserve districts (Huddle and others, 1963). In West Virginia, early (pre-1940) commercial production descriptions for the Winifrede coal bed are found in Headlee and Nolting (1940) for Raleigh, Kanawha, Boone, Logan, and Mingo Counties.

Recent production data by coal zone and State are available from 1976 on in eastern Kentucky and from 1982 on in West Virginia (Appendix 9, table A9–3) and are shown in figure 19. Annual production from the Winifrede/Hazard coal zone exceeded 10 million short tons in the central Appalachian Basin coal region from 1982 through 1996. Cumulative production from the Winifrede/Hazard coal zone in the central Appalachian Basin coal region from 1982 through 1996 was 252 million short tons, of which 122 million short tons (48 percent) was from eastern Kentucky and 130 million short tons (52 percent) was from West Virginia. For the ten-year period 1986 through 1995, mean annual production was 8.0 million short tons in Kentucky and 9.2 million short tons in West Virginia. This coal zone represented 6.6 percent of the total coal production in eastern Kentucky and 6.1 percent of the total coal production in West Virginia reported by the Energy Information Administration (see table 1 in Energy Information Administration, 1995, 1996, 1997, 1998, 2000).

Trends in Winifrede/Hazard coal-zone production by State and by mine type are shown in figure 25. Total production of Winifrede/Hazard coal generally has been between 15 and 20 million short tons from 1982 through 1996. Production by surface mining methods in eastern Kentucky decreased during this period while surface mining of this coal zone increased by 7 million short tons in West Virginia.

The locus of production of the Winifrede/Hazard coal zone is Boone and Logan Counties in the Tug Fork region of southern West Virginia (Appendix 7). These two counties

yielded 70 to 88 percent of the coal zone's production in West Virginia and 30 to 57 percent of its production in the central Appalachian Basin coal region from 1982 through 1996. In Virginia, production from the Morris coal zone is limited to Wise County (Lovett, 1998). In Tennessee, the Pewee coal bed production is mostly in Campbell, Anderson, and Morgan Counties, and the Red Ash coal bed production is in Campbell and Scott Counties (Zurowski and Miller, 1998).

GEOCHEMISTRY

In the Winifrede/Hazard coal zone, 90 complete coalbed samples from 65 locations in eastern Kentucky, 17 locations in West Virginia, 3 locations in Virginia, and 5 locations in Tennessee were analyzed for ash yield, sulfur content, gross calorific value, and arsenic and mercury contents. The apparent rank and sulfur-dioxide (SO_2) emission values were calculated from analytical results. The data were taken from the USGS's COALQUAL database (Bragg and others, 1998) (Appendix 10). The coal zone is dominated by medium and low ash yield (mean is 10.1±5.9 weight percent, range is 2.0 to 28.5 weight percent, as-received whole-coal basis) (Appendix 11, table A11–3) and medium and low sulfur content (mean is 1.04±0.68 weight percent, range is 0.41 to 4.70 weight percent, as-received whole-coal basis) (Appendix 12, table A12–3). The mean sulfur content appears to be higher in eastern Kentucky (1.16±0.77 weight percent, range is 0.41 to 4.70 weight percent) than in West Virginia (0.79±0.20 weight percent, range is 0.20 to 1.15 weight percent), although the large scatter in the data suggests that this difference may not be significant (Appendix 12, table A12–3).

The apparent rank of the Winifrede/Hazard coal zone generally is high volatile A bituminous. Gross calorific values range from a minimum of 8,950 Btu/lb to a maximum of 14,300 Btu/lb, with a mean value of 12,810±1,030 Btu/lb (as-received whole-coal basis) (Appendix 13, table A13–3). The calculated sulfur-dioxide (SO_2) emission levels have a minimum value below compliance (0.75 lbs/million Btu) and a mean value above compliance (1.67±1.16 lbs/million Btu) (Appendix 14, table A14–3).

The mean arsenic content (remnant-moisture whole-coal basis) of the Winifrede/Hazard coal zone is 15±37 ppm (Appendix 15, table A15–3), which is less than the mean for the Appalachian Basin (35 ppm) reported in Finkelman and others (1994) and less than the mean arsenic content for U.S. coal (24 ppm) reported in Finkelman (1993). The mean arsenic content appears to be higher in eastern Kentucky (19±43 ppm) than in West Virginia (3.7±2.8 ppm), although the large scatter in the data in eastern Kentucky suggests that this difference may not be significant (Appendix 15, table A15–3). The mean mercury content (remnant-moisture whole-coal basis) of 0.15±0.17 ppm (Appendix 16, table A16–3) is similar to the means for the Appalachian Basin (0.21 ppm) (Finkelman and others, 1994) and for U.S. coal (0.17 ppm) (Finkelman, 1993). The mean mercury content appears to be higher in eastern Kentucky (0.18±0.18 ppm) than in West Virginia (0.074±0.063 ppm), although the large scatter in the data suggests that this difference may not be significant (Appendix 16, table A16–3).

WILLIAMSON/AMBURGY COAL ZONE

STRATIGRAPHIC POSITION AND NAMES OF CORRELATIVE COAL BEDS

The Williamson/Amburgy coal zone is in the upper part of the Pottsville Group (as used in this report). In eastern Kentucky, the zone is in the upper part of the Pikeville Formation of Chesnut (1992) in the middle of the Breathitt Group as used by Chesnut (1992), between the Kendrick Shale Member (above) and the informally named Elkins Fork shale of Morse (1931) (below) (Rice and Hiett, 1994; Chesnut, 1996, 1997) (fig. 1). In West Virginia, the Williamson/Amburgy coal zone is in the middle division of the Kanawha Formation of Blake (1998), at or near the base of the Dingess Shale Member (above) and above the Campbell Creek limestone of White (1885) (Blake, 1998) (fig. 1). In the Tug Fork region of West Virginia, the Williamson/Amburgy coal zone is between the Dingess limestone of Hennen and Reger (1914) (above) and the Seth limestone of Krebs and Teets (1915) (below) (Blake and others, 1994; Blake, 1998; Martino and others, 1998). In the Kanawha Valley region, the Dingess Shale Member is generally absent and the Alma coal bed overlying the Campbell Creek limestone of White (1885) is considered equivalent to the Williamson/Amburgy coal zone (Blake and others, 1994; Blake, 1998) (fig. 1). However, the Alma and Alma "A" coal beds in the Tug Fork region of West Virginia are placed in the stratigraphically lower Powellton coal zone (Blake and others, 1994; Blake, 1998) (fig. 1). In Virginia, the Williamson/Amburgy coal zone is equivalent to the Low Splint and Low Splint A, B, C, and D coal beds at the top of unit 2 (as used by Nolde, 1994a) of the Wise Formation and is between the Kendrick Shale Member (above) and the Marcum Hollow Sandstone Member (below) (fig. 1). The Low Splint E coal bed is placed stratigraphically below the Williamson/Amburgy coal zone in Virginia (Nolde, 1994a). West of the thrust sheet in Tennessee, the Lower Pioneer coal bed and the incorrectly correlated Jordan coal bed are equivalent to the Williamson/Amburgy coal zone (Rice, 1984) (fig. 1). On the overthrust sheet in Tennessee, the

Poplar Lick and the incorrectly correlated Windrock coal beds are equivalent to the Williamson/Amburgy coal zone (Rice, 1984) (fig. 1). Correlative coal bed names and their geographic distribution are listed in Appendix 1 (table A1–5).

There is confusion over the stratigraphic position and the correlation of the Williamson/Amburgy coal zone in the nomenclature used by the coal mining industry. The mining industry in West Virginia uses the name Peerless coal bed in Boone County, W. Va., for coal that is interpreted to be in the Williamson/Amburgy coal zone (Appendix 2, table A2–5). The former U.S. Bureau of Mines (USBM) bed code 0142, used by mine operators to report coal production to the Energy Information Administration on Form EIA-7A, represents production from the Williamson coal zones in Kentucky and West Virginia and many equivalent coal beds in Kentucky. However, the Alma coal bed has a lower stratigraphic designation, its USBM bed code is 0157 (Thompson and York, 1975), and thus Alma coal bed production in the Kanawha Valley region of West Virginia (fig. 4) would not be included in the Williamson/Amburgy coal zone production reported by the Energy Information Administration.

LOCATION AND EXTENT

The probable original minable extent of the Williamson/Amburgy coal zone is represented approximately by published maps of the Amburgy coal zone and correlative coal beds in eastern Kentucky (see plate 9 in Huddle and others, 1963), the Williamson coal zone and Alma coal bed in West Virginia (see figures 32 and 35 on p. 75 and 82 in Headlee and Nolting, 1940), and undivided unit 2 as used by Nolde (1994a) of the Wise Formation in Virginia (see figure 24 in Nolde, 1994a). The map of the Amburgy and correlative coal beds in eastern Kentucky (see plate 9 in Huddle and others, 1963) may be overly extensive because it includes the Sandstone Parting coal bed, which later work interpreted to be stratigraphically lower and correlative with the Upper Elkhorn No. 3 coal zone (Chesnut, 1997) (fig. 1). Headlee and Nolting (1940) estimated the area of minable coal in the Williamson coal zone and Alma coal bed in West Virginia at 560 and 1,230 mi^2, respectively. However, the part of the Alma coal bed in the Tug Fork region of West Virginia (fig. 4), is correlated with the Upper Elkhorn Nos. 1 and 2/Powellton coal zone (fig. 1; Appendix 1, table A1–5) and is not included in the Williamson/Amburgy coal zone in this report. Thus, approximately three quarters of the Alma coal bed located in the Tug Fork region (see figure 35 on p. 82 in Headlee and Nolting, 1940) should not be included in a map representing the extent of the Williamson/Amburgy coal zone. In Virginia, unit 2 (as used by Nolde, 1994a) of the Wise Formation is almost certainly more extensive than the Low Splint and Low Splint A, B, C, and D coal beds within it.

COAL-BED DESCRIPTION

In eastern Kentucky, Huddle and others (1963) describe the Williamson and Amburgy coal zones and Gun Creek coal bed as bright banded with local cannel coal development. The coal is in two or more benches that split and coalesce, separated by partings or bone coal from a few inches to as much as 50 ft thick (Greb and others, 1999). Above drainage, areas with coal more than 28 in (2.33 ft) thick are restricted in lateral extent (Huddle and others, 1963). Recent exploration has identified substantial resources of the Amburgy coal zone below drainage with an average thickness of 3 ft (Cortland F. Eble, KGS, oral commun., 2000). In the Upper Cumberland River reserve district of eastern Kentucky, the Poplar Lick, Sterling, and Low Splint coal beds (Appendix 1, table A1–5) are generally in two or more benches, with partings that are as much as 1 ft thick; the coal thickness without partings is about 3.5 ft (Huddle and others, 1963). In West Virginia, Headlee and Nolting (1940), Martino and others (1998), and McColloch (1998) describe the Williamson coal zone as being in more than one bed and consisting mostly of splint with some cannel coal. The average thickness is 4 ft with a range of 2 to 8 ft. The Alma coal in central West Virginia is a partly splint coal, generally in a single bed. The average thickness is 3 ft with a range of 2 to 7 ft (Headlee and Nolting, 1940; McColloch, 1998). In southwest Virginia, the Low Splint coal has as many as five benches, A through E; the Low Splint E is placed stratigraphically below the Williamson/Amburgy coal zone (Nolde, 1994a). The benches split and coalesce, with partings between benches measuring from a few inches to 60 ft thick. The benches regionally vary in thickness, with only one or two benches locally measuring more than 1 ft. Each bench is generally less than 2.5 ft thick.

COAL RESOURCES

Identified coal resources for the Williamson/Amburgy coal zone (Appendix 3) were compiled from the USCOAL database (U.S. Geological Survey, 1997). The Williamson/Amburgy coal-zone resources are reported from 12 coal beds in eastern Kentucky, West Virginia, Virginia, and Tennessee (Appendix 4, table A4–4). Coal beds with large resources in the coal zone are the Amburgy coal zone in eastern Kentucky (26 percent of the total resource) and the Alma coal bed in the Kanawha Valley region of West Virginia (35 percent of the total resource). The amount of Williamson/Amburgy coal resource in each

county in the central Appalachian Basin coal region (Appendix 5, table A5–4) is shown in figure 8. Five counties (Letcher, Perry, and Pike Counties, Ky., and Boone and Logan Counties, W. Va.) (fig. 3) together contain more than 50 percent of the resource; each county had more than 300 million short tons of identified Williamson/Amburgy coal-zone resources. The coal zone is estimated to have a total of 4.6 billion short tons (Appendix 6, table A6–4) that are almost equally divided between eastern Kentucky and West Virginia with 2.2 billion short tons in each State (fig. 14). In eastern Kentucky, 35 percent of the Williamson/Amburgy coal-zone resources are greater than 28 in (2.33 ft) thick in the measured and indicated reliability categories (Appendix 6, table A6–4). In West Virginia, 73 percent of the Williamson/Amburgy coal-zone resources were unclassified by thickness and reliability (Appendix 6, table A6–4).

MINING HISTORY

Prior to 1940, the Alma coal was mined in Fayette County, W. Va. (Headlee and Nolting, 1940). Small-scale commercial mining of the Williamson and Amburgy coal zones in the Big Sandy and Hazard reserve districts and small-scale domestic production of the Gun Creek coal bed in the Princess reserve district occurred before 1963 in Kentucky (Huddle and others, 1963).

Recent production data by coal zone and State are available from 1976 on in eastern Kentucky, from 1982 on in West Virginia, and from 1972 on in Virginia (Appendix 9, table A9–4) and are shown in figure 20. Annual production from the Williamson/Amburgy coal zone exceeded 5 million short tons in the central Appalachian Basin coal region from 1984 through 1996. Cumulative production from the Williamson/Amburgy coal zone in the central Appalachian Basin coal region from 1982 through 1996 was 110 million short tons, of which 71 million short tons (65 percent) was from eastern Kentucky. For the ten-year period from 1986 through 1995, mean annual production was 5.3 million short tons in Kentucky, 2.1 million short tons in West Virginia, and 0.6 million short tons in Virginia. The Williamson/Amburgy coal zone represented 4.4 percent of the total coal production in eastern Kentucky, 1.4 percent of the total coal production in West Virginia, and 1.7 percent of the total coal production in Virginia as reported by the Energy Information Administration (see table 1 in Energy Information Administration, 1995, 1996, 1997, 1998, 2000). In 1996, the Low Splint was the ninth largest producing coal bed in Virginia with 1.3 million short tons of production representing 3.5 percent of the Virginia State total (Lovett, 1998).

Trends in Williamson/Amburgy coal-zone production by State and by mine type are illustrated in figure 26. Total production from the coal zone increased overall by about 3 million short tons from 1982 through 1996. The increase reflects an increase in both surface and underground mining in eastern Kentucky (Appendix 9, table A9–4). Production by underground mining exceeded surface production from 1982 through 1996. However, surface mining represents an increasing share of Williamson/Amburgy coal-zone production (Appendix 9, table A9–4).

The locus of production of the Williamson/Amburgy coal zone is eastern Kentucky, which yielded 51 to 75 percent of the coal zone's production in the central Appalachian Basin from 1982 through 1996 (Appendix 9, table A9–4). In West Virginia, Boone and Raleigh Counties in the Kanawha Valley region (figs. 3, 4) yielded 67 to 90 percent of the State's Williamson/Amburgy coal-zone production from 1982 through 1996. In Virginia, recent production from the Low Splint coal bed was all from Wise County (Lovett, 1998).

GEOCHEMISTRY

In the Williamson/Amburgy coal zone, 45 complete coal-bed samples from 34 locations in eastern Kentucky, 2 locations in West Virginia, 3 locations in Virginia, and 6 locations in Tennessee were analyzed for ash yield, sulfur content, gross calorific value, and arsenic and mercury contents. The apparent rank and sulfur-dioxide (SO_2) emission values were calculated from analytical results. The data were taken from the USGS's COALQUAL database (Bragg and others, 1998) (Appendix 10). The coal zone is dominated by medium and low ash yield (mean is 8.76±4.99 weight percent, range is 2.30 to 26.1 weight percent, as-received whole-coal basis) (Appendix 11, table A11–4) and medium and low sulfur content (mean is 1.84±1.25 weight percent, range is 0.59 to 5.80 weight percent, as-received whole-coal basis) (Appendix 12, table A12–4). The mean sulfur content in eastern Kentucky is 1.97±1.23 weight percent, with a range of 0.59 to 5.80 weight percent; however, there are too few samples from West Virginia, Virginia, and Tennessee to make meaningful comparisons (Appendix 12, table A12–4). Further data for ash yield, sulfur content, petrology, and palynology for the Williamson/Amburgy coal zone can be found in Martino and others (1998) and Greb and others (1999).

The apparent rank of the Williamson/Amburgy coal zone generally is high volatile A bituminous. Gross calorific values range from a minimum of 10,380 Btu/lb to a maximum of 14,330 Btu/lb, with a mean value of 13,050±830 Btu/lb (as-received whole-coal basis) (Appendix 13, table A13–4). The calculated sulfur-dioxide (SO_2) emission levels have a minimum value below compliance (0.84 lbs/million Btu) and a mean value above compliance (2.91±2.15 lbs/million Btu) (Appendix 14, table A14–4).

The mean arsenic content (remnant-moisture whole coal basis) of the Williamson/Amburgy coal zone is 29±35 ppm (Appendix 15, table A15–4), which is less than the mean for the Appalachian Basin (35 ppm) reported in Finkelman and others (1994) and more than the mean arsenic content for U.S. coal (24 ppm) reported in Finkelman (1993). The mean arsenic content appears to be higher in eastern Kentucky (34±39 ppm) than for all samples in the central Appalachian Basin (29±35 ppm), although the large scatter in the data suggests that this difference may not be significant (Appendix 15, table A15–4). The mean mercury content (remnant-moisture whole-coal basis) of 0.14±0.11 ppm (Appendix 16, table A16–4) may be lower than the mean for the Appalachian Basin (0.21 ppm) (Finkelman and others, 1994) and similar to the mean for U.S. coal (0.17 ppm) (Finkelman, 1993). The mean mercury content appears to be similar in eastern Kentucky (0.14±0.097 ppm) to the entire sample set in the central Appalachian Basin (Appendix 16, table A16–4).

COALBED METHANE

Coalbed methane content measured in three fresh core samples of the Amburgy coal zone taken from an average depth of 603 ft in Knott County, Ky., was found to be very low at 26 ft^3/t (Diamond and others, 1986; Masemore and others, 1996). However, this may not reflect the coalbed methane content of fairly substantial areas of the Amburgy coal zone that are being developed below drainage (Cortland F. Eble, KGS, oral commun., 2000).

CAMPBELL CREEK/UPPER ELKHORN NO. 3 COAL ZONE

STRATIGRAPHIC POSITION AND NAMES OF CORRELATIVE COAL BEDS

The Campbell Creek/Upper Elkhorn No. 3 coal zone is in the upper part of the Pottsville Group (as used in this report). In eastern Kentucky, the Campbell Creek/Upper Elkhorn No. 3 coal zone is equivalent to the Upper Elkhorn No. 3 coal zone in the Pikeville Formation of Chesnut (1992), near the middle of the Breathitt Group as used by Chesnut (1992), between the informally named Elkins Fork shale of Morse (1931) (above) and the Upper Elkhorn Nos. 1 and 2 coal beds (below) (Rice and Hiett, 1994; Chesnut, 1996, 1997) (fig. 1). By this stratigraphic definition, the Upper Elkhorn No. 3 1/2 coal zone is included in the Campbell Creek/Upper Elkhorn No. 3 coal zone in this report (Appendix 1, table A1–6).

In West Virginia, the coal zone is in the middle division of the Kanawha Formation (as used by Blake, 1998), between the Campbell Creek limestone of White (1885) (above) and the Powellton coal zone (below) (Blake, 1992, 1998; Blake and others, 1994; Martino and others, 1998) (fig. 1). Early work by White (1885) incorrectly correlated the Campbell Creek limestone and the Cannelton limestone from the Kanawha Valley to the Tug Fork region. Subsequent correlation of coal beds from the Kanawha Valley region to the Tug Fork region was based on their stratigraphic position relative to these miscorrelated limestone units. Thus, coal beds with considerable stratigraphic offset were given the same name in the Tug Fork region and the Kanawha Valley region (fig. 1). Recent work by Blake (1992, 1998) and Blake and others (1994) resolved the correlation of the limestone units and coal beds between the Kanawha Valley region and the Tug Fork region and placed many of the marine limestone units and coal beds in the Tug Fork region at a lower stratigraphic position than in the Kanawha Valley region.

In the Kanawha Valley region, the upper and lower splits of the Campbell Creek coal bed historically were named the Peerless (upper bench) and the No. 2 Gas (lower bench) coal beds (Headlee and Nolting, 1940; Rice, Hiett, and Koozmin, 1994). These coal beds are between the Campbell Creek limestone of White (1885) (above) and the Powellton coal zone (below) (Blake, 1992, 1998; Blake and others, 1994; Martino and others, 1998) (fig. 1). In the Tug Fork region, the Campbell Creek/Upper Elkhorn No. 3 coal zone is now considered to be equivalent to the Cedar Grove coal bed and the Lower Cedar Grove coal bed and is between the Seth limestone of Krebs and Teets (1915) (above) and the Alma coal bed (below) (Blake 1992, 1998; Blake and others, 1994) (fig. 1). As a consequence of the recorrelations by Blake (1992, 1998) and Blake and others (1994), several coal beds with the same name are offset stratigraphically in the Kanawha Valley and Tug Fork regions and no longer considered equivalent. Thus, in the Kanawha Valley region, the Cedar Grove coal bed is interpreted to be younger than the Campbell Creek/Upper Elkhorn No. 3 coal zone and is placed stratigraphically above the Williamson/Amburgy coal zone (Blake and others, 1994; Blake, 1998; Martino and others, 1998) (fig. 1). In the Tug Fork region, the Campbell Creek coal bed is now correlated with the Eagle coal bed in the Kanawha Valley region of West Virginia and with the Pond Creek coal zone in eastern Kentucky, below the Crummies Member or its equivalent (Blake and others, 1994; Blake, 1998) (fig. 1; see also Chapter G, this report).

In Virginia and in Kentucky southeast of the Pine Mountain fault on the Cumberland overthrust sheet (fig. 4), the Campbell Creek/Upper Elkhorn No. 3 coal zone is equivalent to the Taggart coal zone (with as many as five

beds, A through E) and the underlying Taggart Marker coal bed, and is between the Marcum Hollow Sandstone Member (above) (fig. 1) and the Clover Fork Sandstone Member (below) (not shown on fig. 1) (Nolde, 1994a,b). West of the Pine Mountain fault and the Cumberland overthrust sheet in Tennessee (fig. 4), the Elk Gap coal bed is considered to be equivalent to the Campbell Creek/Upper Elkhorn No. 3 coal zone, and on the Cumberland overthrust sheet in the Walnut Mountain area of Tennessee, the Jordan coal bed is considered equivalent to this coal zone (Rice, 1984) (fig. 1). Correlative coal-bed names and their geographic distribution are listed in Appendix 1 (table A1–6).

There is confusion over the stratigraphic position and the correlation of the Campbell Creek/Upper Elkhorn No. 3 coal zone in the nomenclature used by the coal mining industry. The mining industry in West Virginia uses the names Peerless, No. 2 Gas, Lower Campbell Creek, Cedar Grove, and Lower Cedar Grove for coal beds that are interpreted to be in the Campbell Creek/Upper Elkhorn No. 3 coal zone (Appendix 2, table A2–6). The former U.S. Bureau of Mines (USBM) bed code 0157, used by mine operators to report coal production to the Energy Information Administration on Form EIA-7A, combines production from the Alma coal bed in West Virginia and the Upper Standiford coal bed in Virginia with the Elkhorn No. 3 coal bed in eastern Kentucky (see table 8 in Energy Information Administration, 1997), although recent work places the Alma coal bed in the Tug Fork region of West Virginia, and the Upper Standiford coal bed in Virginia in the stratigraphically lower Upper Elkhorn Nos. 1 and 2/Powellton coal zone (Blake, 1992, 1998; Blake and others, 1994; Nolde, 1994a,b) (fig. 1; Appendix 1, table A1–7).

LOCATION AND EXTENT

The probable original minable extent of the Campbell Creek/Upper Elkhorn No. 3 coal zone is represented by published maps of the Upper Elkhorn No. 3 coal zone and correlative coal beds in eastern Kentucky (see plate 8 in Huddle and others, 1963), of the Campbell Creek (Peerless) and the Campbell Creek (No. 2 Gas) coal beds in the Kanawha Valley region of West Virginia (see figures 36 and 37 on p. 86 and 89 in Headlee and Nolting, 1940), of the Cedar Grove and Lower Cedar Grove coal beds in the Tug Fork region of West Virginia (see figures 33 and 34 on p. 77 and 81 in Headlee and Nolting, 1940), and of unit 2 (as used by Nolde, 1994a) of the Wise Formation in Virginia (see figure 24 in Nolde, 1994a). The map of the Upper Elkhorn No. 3 and correlative coal beds in eastern Kentucky (see plate 8 in Huddle and others, 1963) may be overly extensive because it includes the Mingo, Jellico, and Straight Creek coal beds, which later work interpreted to be stratigraphically lower and equivalent to the Upper Elkhorn Nos. 1 and 2/Powellton and Pond Creek coal zones (Chesnut, 1997) (fig. 1). Headlee and Nolting estimated the area of minable coal in the Campbell Creek (Peerless) and the Campbell Creek (No. 2 Gas) coal beds to be 750 and 2,100 mi^2, respectively, and the area of minable coal in the Cedar Grove and Lower Cedar Grove coal beds to be 1,470 and 365 mi^2, respectively. However, only the Kanawha Valley region part of the Campbell Creek (Peerless) and the Campbell Creek (No. 2 Gas) coal beds and the Tug Fork region part of the Cedar Grove and Lower Cedar Grove coal beds are correlated with the Campbell Creek/Upper Elkhorn No. 3 coal zone (fig. 1; Appendix 1, table A1–7). Thus, approximately one half of the area of the Campbell Creek (No. 2 Gas) coal bed that is located in the Tug Fork region (see figure 37 on p. 89 in Headlee and Nolting, 1940) and approximately one half of the Cedar Grove coal bed that is located in the Kanawha Valley region (see figure 33 on p. 77 in Headlee and Nolting, 1940) would not be included in a map representing the extent of the Campbell Creek/Upper Elkhorn No. 3 coal zone. In Virginia, unit 2 of Nolde (1994a) of the Wise Formation is almost certainly more extensive than the Taggart and Taggart Marker coal beds within it.

COAL-BED DESCRIPTIONS

In eastern Kentucky, Huddle and others (1963) described several coal beds in the Upper Elkhorn No. 3 coal zone. The Tom Cooper coal bed in the Princess and Licking River reserve districts generally is less than 14 in (1.17 ft) thick; the average thickness in local areas that trend north and east is about 2.5 ft. The Upper Elkhorn No. 3 coal zone in the Big Sandy and Hazard reserve districts generally is a single bed that is more than 32 in (2.66 ft) thick; local pockets have multiple beds and are thicker (3.5-6 ft thick in the Big Sandy reserve district and an average thickness of about 6 ft in the Hazard reserve district). The Sandstone Parting, Kellioka, Darby, and "D" coal beds in the Upper Cumberland reserve district contain single and multiple beds with partings that range from less than an inch to about 1 ft thick. The coal thickness averages about 3 ft in this district, and ranges from 2 to 8 ft. Descriptions of the coal beds in West Virginia that are included in the Campbell Creek coal bed are given by Headlee and Nolting (1940), Martino and others (1998), and McColloch (1998). In the Kanawha Valley region, the Peerless coal bed consists of single to multiple beds of bright banded coal that are 2 to 4 ft thick. A 10- to 25-ft-thick shale parting separates the Peerless coal bed from the No. 2 Gas coal bed below it. The No. 2 Gas coal bed contains multiple beds of splint and bright banded coal with an average thickness of 5 ft and a range of 2 to 8 ft. In the Tug Fork region of West Virginia, the Cedar Grove coal zone consists of more than one bed of splinty coal that

is 2 to 8 ft thick with an average thickness of about 4 ft. The Lower Cedar Grove coal bed, which is about 75 ft below the Cedar Grove coal zone, consists of more than one coal bed of bright banded and splint coal that is 2 to 6 ft thick, with an average thickness of about 4 ft. In Lee and Wise Counties, Va., the Taggart coal bed (upper) and the Taggart Marker coal bed (lower) are separated by 10 to 60 ft or more of clastic rocks; these coals occur as either single or multiple beds (Nolde, 1994a). The Taggart coal bed is 1.5 to 3.5 ft thick and the Taggart Marker coal bed is 2.8 to 6.5 ft thick (Lovett, 1998).

COAL RESOURCES

Identified coal resources for the Campbell Creek/Upper Elkhorn No. 3 coal zone (Appendix 3) were compiled from the USCOAL database (U.S. Geological Survey, 1997). The Campbell Creek/Upper Elkhorn No. 3 coal-zone resources are reported from 15 coal beds in eastern Kentucky, West Virginia, and Virginia (Appendix 4, table A4–5). Coal beds with large resources in the coal zone are the Upper Elkhorn No. 3 coal zone (24 percent of resources) in eastern Kentucky, and the Campbell Creek coal bed (48 percent of total resources) in the Kanawha Valley region of West Virginia. The amount of Campbell Creek/Upper Elkhorn No. 3 coal-zone resource in each county in the central Appalachian Basin coal region (Appendix 5, table A5–5) is shown in figure 9. Five counties in West Virginia (Boone, Kanawha, Logan, Mingo, and Nicholas) contain 45 percent of the resource and each county had more than 900 million short tons of identified Campbell Creek/Upper Elkhorn No. 3 coal-zone resources. The coal zone is estimated to have a total of 13 billion short tons (Appendix 6, table A6–5) that are almost entirely in eastern Kentucky and West Virginia with 4.5 and 8.4 billion short tons respectively (fig. 15). In eastern Kentucky, 57 percent of the Campbell Creek/Upper Elkhorn No. 3 coal-zone resources are greater than 28 in (2.33 ft) thick in the measured and indicated reliability categories (Appendix 6, table A6–5). Thickness and reliability of 70 percent of the coal-zone resource in West Virginia were unclassified (Appendix 6, table A6–5).

MINING HISTORY

In West Virginia, before 1940, the Cedar Grove coal zone and the Lower Cedar Grove coal beds were mined commercially in the Tug Fork region and the No. 2 Gas coal bed was mined in the Kanawha Valley region (Headlee and Nolting, 1940). In Kentucky, before 1963, large commercial operations mined the Upper Elkhorn No. 3 coal zone in the Big Sandy and Hazard reserve districts and extensive mining occurred in the Sandstone Parting and Darby coal beds; the Tom Cooper, "D," and Kellioka coal beds were mined by smaller operations in various other reserve districts (Huddle and others (1963).

Recent production data by coal zone and State are available from 1976 on in eastern Kentucky, from 1982 on in West Virginia, and from 1972 on in Virginia (Appendix 9, table A9–5) and are shown in figure 21. Annual production from the Campbell Creek/Upper Elkhorn No. 3 coal zone exceeded 20 million short tons in the central Appalachian Basin coal region from 1983 through 1996. Cumulative production from the coal zone in the central Appalachian Basin coal region from 1982 through 1996 was 403 million short tons, of which 174 million short tons (43 percent) was from Kentucky, 203 million short tons (50 percent) was from West Virginia, and 26 million short tons (6 percent) was from Virginia. For the ten-year period from 1986 through 1995, mean annual production was 9.2 million short tons in eastern Kentucky, 15 million short tons in West Virginia, and 1.7 million short tons in Virginia. This coal zone represented 9.6 percent of the total coal production in eastern Kentucky, 9.9 percent of the total coal production in West Virginia, and 4.1 percent of the total coal production in Virginia, as reported by the Energy Information Administration (see table 1 in Energy Information Administration, 1995, 1996, 1997, 1998, 2000).

Trends in Campbell Creek/Upper Elkhorn No. 3 coal zone production by State and by mine type are illustrated in figure 27. Total production from the coal zone increased overall by 12 million short tons from 1982 through 1996. The increase reflects an increase in underground mining in both eastern Kentucky and southern West Virginia (Appendix 9, table A9–5). Production by underground mining methods exceeded surface production from 1982 through 1996. A mean of 79 percent of the coal zone's production was by underground mining for the ten-year period from 1986 through 1995.

The locus of production of the Campbell Creek/Upper Elkhorn No. 3 coal zone was fairly evenly split between eastern Kentucky and southern West Virginia from 1982 through 1996 (Appendix 7). In the 1980's, Boone and Raleigh Counties yielded about 50 percent of the coal zone's production in West Virginia (Appendix 7). In 1996, Mingo County yielded 66 percent of the coal zone's production in West Virginia and 34 percent of its total production in the central Appalachian Basin coal region (Appendix 7); a rapid increase in production in Mingo County in the 1990's resulted in the high yields. In Virginia, production from the Taggart coal bed is all from Wise County; production from the Taggart Marker coal bed is reported from Lee and Wise Counties (Lovett, 1998).

GEOCHEMISTRY

In the Campbell Creek/Upper Elkhorn No. 3 coal zone, 142 complete coal-bed samples from 60 locations in eastern Kentucky, 69 locations in West Virginia, and 13 locations in Virginia were analyzed for ash yield, sulfur content, gross calorific value, and arsenic and mercury contents. The apparent rank and sulfur-dioxide (SO_2) emission values were calculated from analytical results. The data were taken from the USGS's COALQUAL database (Bragg and others, 1998) (Appendix 10). The coal zone is dominated by low and medium ash yield (mean is 7.30±3.87 weight percent, range is 0.90 to 21.6 weight percent, as-received whole-coal basis) (Appendix 11, table A11–5) and medium and low sulfur content (mean is 1.35±0.95 weight percent, range is 0.46 to 5.10 weight percent, as-received whole-coal basis) (Appendix 12, table A12–5). The mean sulfur content appears to be higher in eastern Kentucky (1.74±1.20 weight percent, range is 0.46 to 5.10 weight percent) than in West Virginia (1.10±0.59 weight percent, range is 0.50 to 3.20 weight percent) or in Virginia (0.93±0.54 weight percent, range is 0.51 to 2.40 weight percent), although the large scatter in the data suggests that this difference may not be significant (Appendix 12, table A12–5). Further data for ash yield, sulfur content, petrology, and palynology for the Campbell Creek/Upper Elkhorn No. 3 coal zone can be found in Martino and others (1998).

The apparent rank of the Campbell Creek/Upper Elkhorn No. 3 coal zone generally is high volatile A bituminous. Gross calorific values range from a minimum of 9,940 Btu/lb to a maximum of 15,000 Btu/lb, with a mean value of 13,460±780 Btu/lb (as-received whole-coal basis) (Appendix 13, table A13–5). The calculated sulfur-dioxide (SO_2) emission levels have a minimum value below compliance (0.70 lbs/million Btu) and a mean value above compliance (2.04±1.48 lbs/million Btu) (Appendix 14, table A14–5).

The mean arsenic content (remnant-moisture whole-coal basis) of the Campbell Creek/Upper Elkhorn No. 3 coal zone is 17±26 ppm (Appendix 15, table A15–5), which is less than the mean for the Appalachian Basin (35 ppm) reported in Finkelman and others (1994) and less than the mean arsenic content for U.S. coal (24 ppm) reported in Finkelman (1993). The mean arsenic content appears to be higher in eastern Kentucky (27±34 ppm) than in West Virginia (8.7±12 ppm) or Virginia (15±23 ppm), although the large scatter in the data suggests that this difference may not be significant (Appendix 15, table A15–5). The mean mercury content (remnant-moisture whole-coal basis) of 0.13±0.12 ppm (Appendix 16, table A16–5) may be lower than the mean for the Appalachian Basin (0.21 ppm) (Finkelman and others, 1994) and similar to the mean for U.S. coal (0.17 ppm) (Finkelman, 1993). The mean mercury content appears to be similar in eastern Kentucky (0.14±0.12 ppm), West Virginia (0.12±0.13 ppm), and Virginia (0.12±0.066 ppm) (Appendix 16, table A16–5).

COALBED METHANE

Coalbed methane content was measured on one fresh core sample of Upper Elkhorn No. 3 coal from Perry County, Ky., and 16 fresh core samples of Lower Cedar Grove coal from Mingo County, W. Va. (Diamond and others, 1986). The depth of the samples ranged from 400 to 1,037 ft, with a mean of 848 ft. Coalbed methane content ranged from very low to medium with a range of 6 to 144 ft^3/t and a mean of 51 ft^3/t (Diamond and others, 1986; Masemore and others, 1996). Coalbed emissions from five mines in the Campbell Creek/Upper Elkhorn No. 3 coal zone (Cedar Grove coal in Boone County, W. Va.; No. 2 Gas coal in Kanawha County, W. Va.; and Taggart coal in Wise County, Va.) had a range of 0.2 to 0.4 million ft^3 per day (Grau and LaScola, 1984).

UPPER ELKHORN NOS. 1 AND 2/POWELLTON COAL ZONE

STRATIGRAPHIC POSITION AND NAMES OF CORRELATIVE COAL BEDS

The Upper Elkhorn Nos. 1 and 2/Powellton coal zone is in the Pottsville Group as used in this report. In eastern Kentucky, the coal zone is in the middle of the Pikeville Formation of Chesnut (1992) near the middle of the Breathitt Group as used by Chesnut (1992), between the Upper Elkhorn No. 3 coal zone (above) and the Crummies Member (below) (Rice and Hiett, 1994; Chesnut, 1996, 1997) (fig. 1). In southern West Virginia, the Upper Elkhorn Nos. 1 and 2/Powellton coal zone is equivalent to the Powellton coal zone, which is in the middle division of the Kanawha Formation as used by Blake (1998), between the Campbell Creek coal zone (above) and the Crummies Member (below) (Blake, 1992, 1998; Blake and others, 1994) (fig. 1). In the Kanawha Valley region of West Virginia, the zone is equivalent to the Powellton coal bed and is between the No. 2 Gas coal bed of the Campbell Creek coal bed (above) and the Cannelton limestone of White (1885) (below) (Blake, 1992, 1998; Blake and others, 1994) (fig. 1). In the Tug Fork region of West Virginia, the coal zone is equivalent to the Alma coal bed and is below the Lower Cedar Grove coal bed and above the Campbell Creek limestone of White (1885) (Blake, 1992, 1998; Blake

and others, 1994) (fig. 1). In southwestern Virginia, the coal zone is equivalent to the Wilson and Upper St. Charles coal beds that are near the middle of unit 2 (as used by Nolde, 1994a) of the Wise Formation between the Taggart Marker coal bed (above) and an unnamed marine zone (below) (Nolde, 1994a,b) (fig. 1). In Tennessee, the coal zone is equivalent to the Jellico coal zone, which is above the Sand Gap Sandstone Member west of the Pine Mountain fault and Cumberland overthrust sheet, and above the Newcomb Sandstone Member on the Cumberland overthrust sheet (Rice, 1984; Rice, Hiett, and Koozmin, 1994; Chesnut, 1997) (fig. 1). Correlative coal bed names and their geographic distribution are listed in Appendix 1 (table A1–7).

There is confusion over the stratigraphic position and the correlation of the Upper Elkhorn Nos. 1 and 2/Powellton coal zone in the nomenclature used by the coal mining industry. For West Virginia, the names for the Alma coal bed in the Tug Fork region and for the Powellton coal bed in the Kanawha Valley region that are used by the mining industry are listed in Appendix 2 (table A2–7). The former U.S. Bureau of Mines (USBM) bed codes 0154 and 0151 are used by mine operators to report coal production to the Energy Information Administration on Form EIA-7A. USBM bed codes 0154 and 0151 are used for the Elkhorn No. 2 coal bed and the Elkhorn No. 1 coal bed of eastern Kentucky and the Jellico coal zone of Tennessee. However, these bed codes also are used for production from the Cedar Grove coal zone and Lower Cedar Grove coal bed in West Virginia and from the Taggart coal bed in Virginia. Recent work places the Cedar Grove coal zone and Lower Cedar Grove coal bed stratigraphically higher, either in the Campbell Creek/Upper Elkhorn No. 3 coal zone in the Tug Fork region or at an even higher stratigraphic position in the Kanawha Valley region (Blake, 1992, 1998; Blake and others, 1994) (fig. 1). Also, recent work places the Taggart coal bed in Virginia in the stratigraphically higher Campbell Creek/Upper Elkhorn No. 3 coal zone (Nolde, 1994a,b) (fig. 1).

LOCATION AND EXTENT

The probable original minable extent of the Upper Elkhorn Nos. 1 and 2/Powellton coal zone is represented approximately by published maps of the Upper Elkhorn No. 1 coal bed and correlative coal beds in eastern Kentucky (see plate 7 in Huddle and others, 1963), the Powellton and Alma coal beds in West Virginia (see figures 35 and 38 on p. 82 and 93 in Headlee and Nolting, 1940), and the undivided unit 2 (as used by Nolde, 1994a) of the Wise Formation in Virginia (see figure 24 in Nolde, 1994a). The map of the Upper Elkhorn No. 1 coal bed and correlative coal beds in eastern Kentucky (see plate 7 in Huddle and others, 1963) may be overly extensive because it includes the Blue Gem coal bed, which later work interpreted to be stratigraphically lower, below the Crummies Member (Chesnut, 1997) (fig. 1). Headlee and Nolting (1940) estimated the area of minable coal in the Powellton and Alma coal beds in West Virginia at 270 and 1,230 mi^2, respectively. Parts of the Alma and Powellton coal beds in West Virginia have been recorrelated and are not included in the Upper Elkhorn Nos. 1 and 2/Powellton coal zone in this report (fig. 1; Appendix 1, table A1–7). Thus, approximately one quarter of the area of the Alma coal bed located in the Kanawha Valley region (see figure 35 on p. 82 in Headlee and Nolting, 1940), and approximately one half of the Powellton coal bed located in the Tug Fork region (see figure 28 on p. 93 in Headlee and Nolting, 1940) would not be included in a map representing the extent of the Upper Elkhorn Nos. 1 and 2/Powellton coal zone. In Virginia, unit 2 (as used by Nolde, 1994a) of the Wise Formation is almost certainly more extensive than the Upper St. Charles and Wilson coal beds within it.

COAL-BED DESCRIPTION

In eastern Kentucky, Huddle and others (1963) describe several of the coal beds that compose the Upper Elkhorn Nos. 1 and 2 coal zone listed in Appendix 1 (table A1–7). The Grassy coal zone in the Princess and Licking River reserve districts generally is a bright banded coal, locally a dull splint or cannel coal, and is typically less than 18 in (1.5 ft) thick. The Upper Elkhorn No. 2 and the Upper Elkhorn No. 1 coal beds in the Big Sandy and Hazard reserve districts are separated by a clastic parting 10 to 60 ft thick, except where the coal beds merge to form one bed in Floyd and Pike Counties. The Grassy coal zone in the northwestern part of the Hazard reserve district may also represent a merging of coal benches. The Upper Elkhorn No. 2 coal bed ranges from about 2 to more than 3 ft; the Upper Elkhorn No. 1 coal bed commonly is less than 28 in (2.33 ft) thick, with pockets as much as 4.5 ft thick. The Jellico coal zone in the Southwestern reserve district generally is found as a single bed that is often more than 3.5 ft thick. The Moss coal bed in the Southwestern reserve district has an average thickness of 2.5 ft, has partings usually less than 20 in thick, and may have a 12-in-thick rider coal less than 10 ft above it. The Mingo coal bed in the Middlesboro subdistrict can be either a single bed about 2 to 3.5 ft thick or two benches with a total thickness of 3.5 to 5.5 ft of coal with 4- to 8-in-thick parting near the middle of the coal. The Harlan coal zone in the Harlan subdistrict goes from a single bed with an average thickness of 3 ft, to three benches, each about 3 ft thick and separated by 8 to 10 ft of sandstone.

In West Virginia, Headlee and Nolting (1940) and McColloch (1998) describe coal beds in the Powellton coal zone. In the Kanawha Valley region, the Powellton coal bed consists of multiple beds of soft coal with a thickness that

averages 4 ft and ranges from 2 to 11 ft. In the Tug Fork region, the Alma coal bed consists of multiple beds of soft and splint coal, often with a fireclay parting near the bottom of the coal. The Alma coal bed is 3 to 5 ft thick in Wyoming and McDowell Counties and 2 to 7 ft thick in Logan, Mingo, and Wyoming Counties.

In Virginia, Nolde (1994a) gives coal-bed thickness information for equivalent coal beds in the Upper Elkhorn Nos. 1 and 2/Powellton coal zone (Appendix 1, table A1–7). In Lee and Wise Counties, the Wilson coal bed thickness averages about 2.5 ft, with a maximum of about 5 ft. In Buchanan County, the Upper Alma coal bed is about 2 to 6 ft thick. The Wilson and Upper Alma coal beds (equivalent to the Upper Elkhorn No. 2 coal bed) occur 15 to 70 ft and 50 ft, respectively, above the Upper St. Charles and Alma coal beds (equivalent to the Upper Elkhorn No. 1 coal bed). The Upper St. Charles coal bed thickness averages 1.5 ft; the Alma coal bed is as much as 4 ft thick.

In Tennessee, the coal beds equivalent to the Upper Elkhorn Nos. 1 and 2/Powellton coal zone (Appendix 1, table A1–7) are described by Zurowski and Miller (1998). The Jellico coal zone is a medium to hard, bright coal that occurs as a single bed with a thickness that averages 3.5 ft and ranges from 3 to 5.5 ft; it can have one or two partings that are 1 to 12 in thick. The Brushy Mountain and State coal beds occur as single beds that are 3 to 4 ft thick and may have a single parting that is 2 to 14 in thick. The Mingo coal bed is 5 to 6 ft thick in two or more benches that are mined together where the partings are thin.

COAL RESOURCES

Identified coal resources for the Upper Elkhorn Nos. 1 and 2/Powellton coal zone (Appendix 3) were compiled from the USCOAL database (U.S. Geological Survey, 1997). The Upper Elkhorn Nos. 1 and 2/Powellton coal-zone resources are reported from 19 coal beds in eastern Kentucky, West Virginia, Virginia, and Tennessee (Appendix 4, table A4–6). Coal beds with large resources in the coal zone are the Upper Elkhorn No. 2 coal bed (22 percent of the total resource) and the Upper Elkhorn No. 1 coal bed (17 percent of the resource) in eastern Kentucky, and the Alma coal bed (18 percent of the resource) in the Tug Fork region of West Virginia. The amount of Upper Elkhorn Nos. 1 and 2/Powellton coal-zone resource in each county in the central Appalachian Basin coal region (Appendix 5, table A5–6) is shown in figure 10. Four counties (Floyd, Harlan, and Pike Counties, Ky.; and Logan County, W. Va.) contain more than 50 percent of the resource, and each county had more than 800 million short tons of identified Upper Elkhorn Nos. 1 and 2/Powellton coal-zone resources. The coal zone is estimated to have a total of 8.2 billion short tons (Appendix 6, table A6–6) that are almost entirely in eastern Kentucky and West Virginia, with 5.7 and 2.1 billion short tons, respectively (fig. 16). In eastern Kentucky, 51 percent and, in West Virginia, 57 percent of the State's Upper Elkhorn Nos. 1 and 2/Powellton coal-zone resources are greater than 28 in (2.33 ft) thick in the measured and indicated reliability categories (Appendix 6, table A6–6). Thickness and reliability of 28 percent of the Upper Elkhorn Nos. 1 and 2/Powellton coal resource in West Virginia were unclassified (Appendix 6, table A6–6).

MINING HISTORY

In Kentucky, Huddle and others (1963) reported extensive mining of the Harlan coal zone and Mingo coal bed in the Upper Cumberland River reserve district and the Jellico coal zone in the Southwestern reserve district. The Upper Elkhorn No. 1 and the Upper Elkhorn No. 2 coal beds were mined in the Big Sandy reserve district (Huddle and others, 1963). The Collier coal bed was mined locally and the Grassy coal zone was no longer being mined (Huddle and others, 1963). In West Virginia, Headlee and Nolting (1940) indicated that the Powellton coal bed was mined in the Kanawha Valley region in Fayette and Kanawha Counties, and the Alma coal bed was mined in the Tug Fork region in Boone, Logan, and Mingo Counties.

Recent production data by coal zone and State are available from 1976 on in eastern Kentucky, from 1982 on in West Virginia, and from 1972 on in Virginia (Appendix 9, table A9–6) and are shown in figure 22. Annual production of the Upper Elkhorn Nos. 1 and 2/Powellton coal zone exceeded 15 million short tons in the central Appalachian Basin coal region from 1984 through 1996. Cumulative production from the coal zone in the central Appalachian Basin coal region from 1982 through 1996 was 348 million short tons, of which 250 million short tons (72 percent) was from eastern Kentucky. For the ten-year period from 1986 through 1995, mean annual production was 18 million short tons in Kentucky, 6.7 million short tons in West Virginia, and 1.0 million short tons in Virginia. This coal zone represented 15 percent of the total coal production in eastern Kentucky, 4.4 percent of the total coal production in West Virginia, and 2.5 percent of the total coal production in Virginia as reported by Energy Information Administration (see table 1 in Energy Information Administration, 1995, 1996, 1997, 1998, 2000).

Trends in Upper Elkhorn Nos. 1 and 2/Powellton coal-zone production by State and by mine type are illustrated in figure 28. Total production of the coal zone increased overall by 15 million short tons from 1982 through 1996. The increase reflects an increase in production in both Kentucky (both surface and underground mining) and in West Virginia

(primarily in underground mining) (Appendix 9, table A9–6). Production by underground mining methods exceeded surface production from 1982 through 1996.

The locus of production of the Upper Elkhorn Nos. 1 and 2/Powellton coal zone is in eastern Kentucky, which yielded 63 to 82 percent of the total coal-zone production in the central Appalachian Basin coal region from 1982 through 1996 (Appendix 7). Boone, Mingo, and Raleigh Counties in southern West Virginia yielded 82 to 96 percent of the coal zone's production in West Virginia from 1982 through 1996 (Appendix 7). In Virginia, production from the Wilson coal bed is mostly from Lee and Wise Counties (Lovett, 1998). In Tennessee, the Jellico coal zone and its equivalents are mined in Anderson, Campbell, Claiborne, Morgan, and Scott Counties (Zurowski and Miller, 1998).

GEOCHEMISTRY

In the Upper Elkhorn Nos. 1 and 2/Powellton coal zone, 114 complete coal-bed samples from 81 locations in eastern Kentucky, 23 locations in West Virginia, 6 locations in Virginia, and 4 locations in Tennessee were analyzed for ash yield, sulfur content, gross calorific value, and arsenic and mercury contents. The apparent rank and sulfur-dioxide (SO_2) emission values were calculated from analytical results. The data were taken from the USGS's COALQUAL database (Bragg and others, 1998) (Appendix 10). The coal zone is dominated by low and medium ash yield (mean is 6.81±3.91 weight percent, range is 1.60 to 22.4 weight percent, as-received whole-coal basis) (Appendix 11, table A11–6) and medium and low sulfur content (mean is 1.59±1.28 weight percent, range is 0.50 to 6.60 weight percent, as-received whole-coal basis) (Appendix 12, table A12–6). The mean sulfur content appears to be higher in eastern Kentucky (1.73±1.36 weight percent, range is 0.51 to 6.60 weight percent) than in West Virginia (0.86±0.29 weight percent, range is 0.50 to 1.50 weight percent), although the large scatter in the data suggests that this difference may not be significant (Appendix 12, table A12–6).

The apparent rank of the Upper Elkhorn Nos. 1 and 2/Powellton coal zone generally is high volatile A bituminous. Gross calorific values range from a minimum of 11,120 Btu/lb to a maximum of 14,630 Btu/lb, with a mean value of 13,530±740 Btu/lb (as-received whole-coal basis) (Appendix 13, table A13–6). The calculated sulfur-dioxide (SO_2) emission levels have a minimum value below compliance (0.72 lbs/million Btu) and a mean value above compliance (2.39±2.01 lbs/million Btu) (Appendix 14, table A14–6).

The mean arsenic content (remnant-moisture whole-coal basis) of the Upper Elkhorn Nos. 1 and 2/Powellton coal zone is 42±90 ppm (Appendix 15, table A15–6), which is greater than the mean for the Appalachian Basin (35 ppm) reported in Finkelman and others (1994) and greater than the mean arsenic content for U.S. coal (24 ppm) reported in Finkelman (1993). The mean arsenic content appears to be higher in eastern Kentucky (52±100 ppm) than in West Virginia (12±16 ppm), although the large scatter in the data suggests that this difference may not be significant (Appendix 15, table A15–6). The mean mercury content (remnant-moisture whole-coal basis) of 0.16±0.14 ppm (Appendix 16, table A16–6) is similar to the means for the Appalachian Basin (0.21 ppm) (Finkelman and others, 1994) and for U.S. coal (0.17 ppm) (Finkelman, 1993). The mean mercury content appears to be similar in eastern Kentucky (0.17±0.14 ppm) and West Virginia (0.15±0.18 ppm) (Appendix 16, table A16–6).

COALBED METHANE

Coalbed methane content was measured on 12 fresh core samples of Alma coal from Mingo County, W. Va. (Diamond and others, 1986). The depth of the samples ranged from 754 to 1,059 ft (mean of 940 ft) and coalbed methane content ranged from very low to medium with a range of 9 to 114 ft^3/t and a mean of 53 ft^3/t (Diamond and others, 1986; Masemore and others, 1996). Coalbed methane emissions from five mines in the Upper Elkhorn Nos. 1 and 2/Powellton coal zone (Powellton coal bed in Kanawha County, W. Va.; Alma coal bed in Mingo County, W. Va.; Harlan coal bed in Harlan County, Ky.; and Jellico coal zone in Claiborne County, Tenn.) had a range of 0.1 to 0.3 million ft^3 per day (Grau and LaScola, 1984).

CONCLUSIONS

This compilation of estimated resources, recent coal production, and coal quality information indicates that the No. 5 Block, Stockton and Coalburg, Winifrede/Hazard, Williamson/Amburgy, Campbell Creek/Upper Elkhorn No. 3, and Upper Elkhorn Nos. 1 and 2/Powellton coal zones are significant coal zones of the Appalachian Basin and will likely continue to be important coal producers in the near future. All six coal zones are located in the central Appalachian Basin coal region in the lower part of the Allegheny Group and the upper and middle parts of the Pottsville Group, in a region and in strata that generally have good quality medium- to low-ash and medium- to low-sulfur coal.

The estimated resources of these six coal zones are large: 4.6 to 13 billion short tons in each zone. The resource estimates are based on data that are now more than 40 years old. Many of the coal beds in these coal zones have had significant production since the coal-resource data was esti-

mated. A detailed assessment of the coal zones' thickness, mined-out areas, depth of burial, and regional distribution of quality would be necessary to reliably calculate the current remaining resources. With the exception of the Williamson/Amburgy coal zone, the annual production from these coal zones from 1982 through 1996 is more than 10 million short tons. The trend of increasing production in all coal zones, except the Winifrede/Hazard coal zone, suggests that these coal zones will be important coal producers in the near future. Ash yields and sulfur contents are in the medium to low range in all six coal zones. Much of the coal meets current sulfur-dioxide emissions regulations without beneficiation. Mean concentrations of the environmentally harmful trace elements, arsenic and mercury, are below the mean for all Appalachian Basin coal, except for arsenic in the Upper Elkhorn Nos. 1 and 2/Powellton coal zone. These coal zones contain desirable resources for power generation.

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APPENDIX 1

CORRELATIVE COAL-BED OR COAL-ZONE NAMES FOR EACH COAL ZONE IN THE CENTRAL APPALACHIAN BASIN COAL REGION BY STATE

[The convention for coal-bed or coal-zone names in this Appendix follows Rice, Hiett, and Koozmin (1994) or figure 1. Although many coal beds (or coal zones) in this Appendix also are referred to as coal zones (or coal beds) in States' publications, both variations are not listed in this Appendix.]

Table A1–1. No. 5 Block coal zone correlative coal-bed and coal-zone names in the central Appalachian Basin coal region, by State.

[Sources: Headlee and Nolting (1940); Huddle and others (1963); Eble (1994); Rice and Hiett (1994); Rice, Hiett, and Koozmin (1994); Chesnut (1996, 1997); Blake (1998); Bascombe M. Blake, Jr., West Virginia Geological and Economic Survey, oral commun. (1998); John K. Hiett and Dan O'Canna, Kentucky Department of Mines and Minerals, written commun. (1998); McColloch (1998); Donald R. Chesnut, Jr., and Cortland F. Eble, Kentucky Geological Survey, written commun. (1999).]

State	Name of Coal Beds or Coal Zones (Local mining industry name for coal bed) [Coal bed or coal zone that is not correlative]	Notes	Region, District, Coal Field, or County
KY	bed codes 820010-820199	Kentucky Department of Mines and Minerals	eastern Kentucky coal field
KY	Princess No. 5 coal zone		Princess and Licking River reserve districts
KY	Richardson coal zone	May be Little No. 5 Block coal bed	Princess, Licking River, Big Sandy, and Hazard reserve districts
KY	Skyline coal zone		Licking River and Hazard reserve districts
KY	No. 5 Block coal bed		Big Sandy reserve district
KY	Knob coal zone		Hazard and Southwestern reserve districts
KY	Hazard No. 11 coal zone		Southwestern reserve district
KY	Eroded		Upper Cumberland River reserve district (Middlesboro and Harlan subdistricts)
TN	Eroded		Cumberland overthrust sheet and west of Cumberland overthrust sheet
VA	Eroded		Southwest Virginia coal field
WV	Upper No. 5 Block coal bed		Tug Fork and Kanawha Valley regions
WV	(Middle Kittanning coal bed)		Tug Fork and Kanawha Valley regions
WV	No. 5 Block coal bed		Tug Fork and Kanawha Valley regions
WV	(Mahoning coal bed)		Nicholas County
WV	(Upper Freeport coal bed)		Braxton, Logan, Mingo, Nicholas, and Webster Counties
WV	(Lower Freeport coal bed)		Braxton, Mingo, and Nicholas Counties
WV	(Upper Kittanning rider coal bed)		Webster County
WV	(Lower Kittanning coal bed)		Tug Fork and Kanawha Valley regions
WV	Lower No. 5 Block coal bed		Tug Fork and Kanawha Valley regions
WV	[Little No. 5 Block coal bed]	Coal by this name is not equivalent in this region	Tug Fork and Kanawha Valley regions

APPENDIX 1—CONTINUED

Table A1–2. Stockton coal zone correlative coal-bed and coal-zone names in the central Appalachian Basin coal region, by State.

[Sources: Headlee and Nolting (1940); Huddle and others (1963); Eble (1994); Nolde (1994a,b); Rice and Hiett (1994); Rice, Hiett, and Koozmin (1994); Chesnut (1996, 1997); Blake (1998); Bascombe M. Blake, Jr., West Virginia Geological and Economic Survey, oral commun. (1998); John K. Hiett and Dan O'Canna, Kentucky Department of Mines and Minerals, written commun. (1998); McColloch (1998); Donald R. Chesnut, Jr., and Cortland F. Eble, Kentucky Geological Survey, written commun. (1999).]

State	Name of Coal Beds or Coal Zones (Local mining industry name for coal bed) [Coal bed or coal zone that is not correlative]	Notes	Region, District, Coal Field, or County
KY	bed codes 810010-811999	Kentucky Department of Mines and Minerals	eastern Kentucky coal field
KY	Broas coal zone		Princess, Licking River, Big Sandy, Hazard, and Southwestern reserve districts
KY	Princess No. 4 coal bed		Princess reserve district
KY	Torchlight coal zone		Princess reserve district
KY	Tiptop coal bed		Licking River and Hazard reserve districts
KY	Hindman coal bed		Licking River, Hazard, and Southwestern reserve districts
KY	(Clarion coal bed)		Big Sandy reserve district
KY	Hazard No. 10 coal zone		Hazard and Southwestern reserve districts
KY	Hazard No. 9 coal zone		Hazard and Southwestern reserve districts
KY	Helton coal bed		Hazard reserve district
KY	Eroded		Upper Cumberland River reserve district (Middlesboro subdistrict)
KY	Sam's Ridge coal bed		Upper Cumberland River reserve district (Harlan subdistrict)
KY	upper Black Mountain coal zone		Upper Cumberland River reserve district (Harlan subdistrict)
KY	middle Black Mountain coal zone		Upper Cumberland River reserve district (Harlan subdistrict)
TN	Eroded		Cumberland overthrust sheet and west of Cumberland overthrust sheet
VA	No. 13 coal bed		Southwest Virginia coal field
WV	[Stockton "A" coal bed]	Coal by this name is not equivalent in this region	Tug Fork and Kanawha Valley regions
WV	Stockton Rider coal bed		Tug Fork and Kanawha Valley regions
WV	Stockton coal bed		Tug Fork and Kanawha Valley regions
WV	(Middle Kittanning coal bed)		Braxton and Webster Counties
WV	Stockburg coal bed	Name used locally where Stockton and Coalburg coal beds merge	Boone and Kanawha Counties
WV	Stockton-Lewiston coal bed	Old name, used by mining industry	Tug Fork and Kanawha Valley regions
WV	Lewiston coal bed	Old name, no longer used	Tug Fork and Kanawha Valley regions
WV	Kanawha Splint coal bed	Name used locally	Tug Fork and Kanawha Valley regions

APPENDIX 1—CONTINUED

Table A1–3. Coalburg coal zone correlative coal-bed and coal-zone names in the central Appalachian Basin coal region, by State.

[Sources: Headlee and Nolting (1940); Huddle and others (1963); Rice (1984); Eble (1994); Nolde (1994a,b); Rice and Hiett (1994); Rice, Hiett, and Koozmin (1994); Chesnut (1996, 1997); Blake (1998); Bascombe M. Blake, Jr., West Virginia Geological and Economic Survey, oral commun. (1998); John K. Hiett and Dan O'Canna, Kentucky Department of Mines and Minerals, written commun. (1998); McColloch (1998); Zurowski and Miller (1998); Donald R. Chesnut, Jr., and Cortland F. Eble, Kentucky Geological Survey, written commun. (1999); Charles L. Rice, U.S. Geological Survey (retired), oral commun. (1999).]

State	Name of Coal Beds or Coal Zones (Local mining industry name for coal bed)	Notes	Region, District, Coal Field, or County
KY	bed codes 730005-731999	Kentucky Department of Mines and Minerals	eastern Kentucky coal field
KY	Peach Orchard coal zone		Princess, Licking River, Big Sandy, and Hazard reserve districts
KY	Princess No. 3 coal bed		Princess reserve district
KY	Clod coal bed	Old name, no longer used	Princess reserve district
KY	No. 3 Clod coal bed	Old name, no longer used	Princess reserve district
KY	Hitchens No. 3 coal bed	Old name, no longer used	Princess reserve district
KY	Top Hill coal bed	Old name, no longer used	Princess reserve district
KY	Mudseam coal bed		Princess, Licking River, and Big Sandy reserve districts
KY	Nickell coal bed		Princess, Licking River, and Hazard reserve districts
KY	Lenox coal bed		Licking River reserve district
KY	Hatcher coal bed		Licking River and Big Sandy reserve districts
KY	Sebastian coal bed		Licking River and Hazard reserve districts
KY	Fugate coal bed		Licking River and Hazard reserve districts
KY	Oakley coal bed		Licking River and Hazard reserve districts
KY	Flag coal bed		Licking River and Hazard reserve districts
KY	Coalburg coal bed		Big Sandy reserve district
KY	Hazard No. 8 coal bed		Hazard and Southwestern reserve districts
KY	Hazard No. 7 coal zone		Licking River, Hazard, and Southwestern reserve districts
KY	Francis coal zone		Hazard reserve district
KY	Francis No. 8 coal bed	Kentucky Department of Mines and Minerals	Hazard reserve district
KY	lower Black Mountain coal zone		Upper Cumberland River reserve district (Harlan subdistrict)
KY	Bluff Spur coal zone		Upper Cumberland River reserve district (Harlan subdistrict)
KY	High Splint coal bed		Upper Cumberland River reserve district (Harlan subdistrict)
KY	Big Wheel coal bed		Upper Cumberland River reserve district (Harlan subdistrict)
TN	Hazard No. 9 coal bed		west of Cumberland overthrust sheet
TN	Hindman coal bed		west of Cumberland overthrust sheet
TN	Big Wheel coal bed		west of Cumberland overthrust sheet
TN	Eroded		Cumberland overthrust sheet
VA	High Splint coal bed		Southwest Virginia coal field
VA	No. 12 coal bed		Southwest Virginia coal field
WV	Stockburg coal bed		Boone and Kanawha Counties
WV	Coalburg "A" coal bed		Tug Fork and Kanawha Valley regions
WV	Coalburg coal bed		Tug Fork and Kanawha Valley regions
WV	(Lower Kittanning coal bed)		Braxton and Webster Counties
WV	(Winifrede coal bed)		Wayne County
WV	Little Coalburg coal bed		Tug Fork and Kanawha Valley regions

APPENDIX 1—CONTINUED

Table A1–4. Winifrede/Hazard coal zone correlative coal-bed and coal-zone names in the central Appalachian Basin coal region with Upper Winifrede and Hazard equivalent coal beds listed first followed by Lower Winifrede and Haddix equivalent coal beds, by State.

[Sources: Headlee and Nolting (1940); Huddle and others (1963); Rice (1984); Nolde (1994a,b); Rice and Hiett (1994); Rice, Hiett, and Koozmin (1994); Chesnut (1996, 1997); Blake (1998); Bascombe M. Blake, Jr., West Virginia Geological and Economic Survey, oral commun. (1998); John K. Hiett and Dan O'Canna, Kentucky Department of Mines and Minerals, written commun. (1998); McColloch (1998); Zurowski and Miller (1998); Donald R. Chesnut, Jr., and Cortland F. Eble, Kentucky Geological Survey, written commun. (1999).]

State	Name of Coal Beds or Coal Zones (Local mining industry name for coal bed) [Coal bed or coal zone that is not correlative]	Notes	Region, District, Coal Field, or County
		Coal beds equivalent to the Upper Winifrede and Hazard coals	
KY	bed codes 720010-720999	Kentucky Department of Mines and Minerals	eastern Kentucky coal field
KY	Hazard coal zone		Princess, Licking River, Big Sandy, Hazard, and Southwestern reserve districts
KY	(Winifrede coal bed)	Kentucky Department of Mines and Minerals	eastern Kentucky coal field
KY	Prater coal zone		Licking River and Hazard reserve districts
KY	Index coal bed		Licking River reserve district
KY	Adele coal bed		Licking River and Hazard reserve districts
KY	Black Gem coal zone		Big Sandy reserve district
KY	Hazard No. 6 coal bed		Hazard reserve district
KY	Hazard No. 5A coal bed		Hazard reserve district
KY	Leatherwood coal bed		Hazard reserve district
KY	Lea coal zone		Southwestern reserve district
KY	Red Springs coal bed		Upper Cumberland River reserve district (Middlesboro subdistrict)
KY	(Middle Splint coal bed)	Kentucky Department of Mines and Minerals	Upper Cumberland River reserve district (Middlesboro subdistrict)
KY	Lower Hignite coal bed		Upper Cumberland River reserve district (Middlesboro subdistrict) (?)
KY	Morris coal zone		Upper Cumberland River reserve district (Harlan subdistrict)
KY	Cornett coal bed	Old name, no longer used	Upper Cumberland River reserve district (Harlan subdistrict)
KY	Braden Mountain coal bed		Southwestern reserve district (?)
TN	Braden Mountain coal bed		west of Cumberland overthrust sheet
TN	Pewee coal bed		west of Cumberland overthrust sheet
TN	Hazard No. 5A coal bed		west of Cumberland overthrust sheet
TN	Merwin coal bed	Name used locally	west of Cumberland overthrust sheet, Anderson County
TN	"X" coal bed	Old name, no longer used	west of Cumberland overthrust sheet, Anderson County
TN	Jumbo coal bed	Uncertain correlation	west of Cumberland overthrust sheet
TN	Lower Hignite coal bed	Uncertain correlation	west of Cumberland overthrust sheet
TN	Eroded		Cumberland overthrust sheet
TN	Red Springs coal bed		Cumberland overthrust sheet
TN	[Walnut Mountain coal bed]	Coal by this name is not equivalent in this region	Cumberland overthrust sheet
VA	Morris coal zone		Southwest Virginia coal field
VA	No. 11 coal bed		Southwest Virginia coal field
VA	Cornett coal bed	Local name for Morris coal bed	Southwest Virginia coal field
WV	Winifrede coal bed		Tug Fork and Kanawha Valley regions
WV	Upper Winifrede coal bed		Tug Fork and Kanawha Valley regions
WV	Buffalo Creek coal bed		Tug Fork region
WV	Upper Buffalo Creek coal bed		Tug Fork region
WV	(Clarion coal bed)		Braxton and Webster Counties
WV	Dorothy coal bed		Kanawha Valley

Table A1–4.—Continued.

State	Name of Coal Beds or Coal Zones (Local mining industry name for coal bed) [Coal bed or coal zone that is not correlative]	Notes	Region, District, Coal Field, or County
	Coal beds equivalent to the Lower Winifrede and Haddix coals		
KY	bed codes 710010-710199	Kentucky Department of Mines and Minerals	eastern Kentucky coal field
KY	Haddix coal zone		Princess, Licking River, Big Sandy, Hazard, and Southwestern reserve districts
KY	(Hazard No. 5 coal bed)		Princess, Licking River, Big Sandy, Hazard, and Southwestern reserve districts
KY	Colvin coal bed		Licking River and Hazard reserve districts
KY	Meatscaffold coal zone		Licking River and Southwestern reserve districts
KY	Trace Fork coal bed		Licking River, Big Sandy, and Hazard reserve districts
KY	Upper Young coal bed	Old name, no longer used	Licking River reserve district
KY	Lower Young coal bed	Old name, no longer used	Licking River reserve district
KY	Whitaker coal bed	Old name, no longer used	Licking River reserve district
KY	Flatwoods coal bed	Old name, no longer used	Big Sandy reserve district
KY	Red Ash coal bed	Kentucky Department of Mines and Minerals	Southwestern reserve district
KY	Low Splint coal bed	Local name	Upper Cumberland River reserve district (Middlesboro subdistrict)
KY	Lower Highsplint coal bed		Upper Cumberland River reserve district (Harlan subdistrict)
TN	Red Ash coal bed		west of Cumberland overthrust sheet
WV	Lower Winifrede coal bed		Tug Fork and Kanawha Valley regions
WV	Lower Buffalo Creek coal bed		Tug Fork region

APPENDIX 1—CONTINUED

Table A1–5. Williamson/Amburgy coal zone correlative coal-bed and coal-zone names in the central Appalachian Basin coal region, by State.

[Sources: Headlee and Nolting (1940); Huddle and others (1963); Rice (1984); Nolde (1994a,b); Rice and Hiett (1994); Rice, Hiett, and Koozmin (1994); Chesnut (1996, 1997); Blake (1998); Bascombe M. Blake, Jr., West Virginia Geological and Economic Survey, oral commun. (1998); John K. Hiett and Dan O'Canna, Kentucky Department of Mines and Minerals, written commun. (1998); McColloch (1998); Zurowski and Miller (1998); Donald R. Chesnut, Jr., and Cortland F. Eble, Kentucky Geological Survey, written commun. (1999).]

State	Name of Coal Beds or Coal Zones (Local mining industry name for coal bed) [Coal bed or coal zone that is not correlative]	Notes	Region, District, Coal Field, or County
KY	bed codes 580010-581999	Kentucky Department of Mines and Minerals	eastern Kentucky coal field
KY	Williamson coal zone		Princess, Licking River, and Big Sandy reserve districts
KY	(Elkhorn No. 4 coal bed)	Kentucky Department of Mines and Minerals	Princess, Licking River, and Big Sandy reserve districts
KY	Gun Creek coal bed		Princess, Licking River, and Big Sandy reserve districts
KY	Cannel City coal zone		Princess, Licking River, and Hazard reserve districts
KY	Amburgy Rider coal bed		Hazard Reserve District
KY	Amburgy coal zone		Big Sandy, Hazard, and Southwestern reserve districts
KY	[Alma coal bed]	Coal by this name is not equivalent in this region	Big Sandy, Hazard, and Southwestern reserve districts
KY	Mills coal bed	Uncertain correlation	Southwestern reserve district
KY	(Lower Pioneer coal bed)	Kentucky Department of Mines and Minerals	Southwestern reserve district
KY	Jordan coal bed	Uncertain correlation	Southwestern reserve district
KY	Sterling coal bed		Upper Cumberland River reserve district (Middlesboro subdistrict)
KY	Klondike coal bed		Upper Cumberland River reserve district (Middlesboro subdistrict)
KY	Poplar Lick coal bed		Upper Cumberland River reserve district (Middlesboro subdistrict)
KY	Creech coal zone		Upper Cumberland River reserve district (Harlan subdistrict)
KY	Upper Taggart coal zone		Upper Cumberland River reserve district (Harlan subdistrict)
KY	Low Splint coal bed		Upper Cumberland River reserve district (Harlan subdistrict)
KY	"E" coal bed		Upper Cumberland River reserve district (Harlan subdistrict)
TN	[Upper Pioneer coal bed]	Coal by this name is not equivalent in this region	west of Cumberland overthrust sheet
TN	Sterling coal bed		Claiborne County
TN	Klondike coal bed		Claiborne County
TN	Pioneer coal bed		west of Cumberland overthrust sheet
TN	Lower Pioneer coal bed		west of Cumberland overthrust sheet
TN	Jordan coal bed	Coal bed was named in this region based on an incorrect correlation from another region	west of Cumberland overthrust sheet
TN	[Jordan coal bed]	Coal by this name is older and is not equivalent in this region	Cumberland overthrust sheet
TN	Norman Pond coal bed	Uncertain correlation	west of Cumberland overthrust sheet
TN	Low Splint coal bed	Uncertain correlation	west of Cumberland overthrust sheet
TN	Windrock coal bed	Coal bed was named in this region based on an incorrect correlation from another region	Cumberland overthrust sheet
TN	[Windrock coal bed]	Coal by this name is younger and is not equivalent in this region	west of Cumberland overthrust sheet
TN	Poplar Lick coal bed		Cumberland overthrust sheet

Table A1–5.—Continued.

State	Name of Coal Beds or Coal Zones (Local mining industry name for coal bed) [Coal bed or coal zone that is not correlative]	Notes	Region, District, Coal Field, or County
VA	Low Splint coal bed		Southwest Virginia coal field
VA	Low Splint A, B, C, D coal beds		Southwest Virginia coal field
VA	[Low Splint E coal bed]	Equivalent to stratigraphically lower coal	Southwest Virginia coal field
VA	No. 6 coal bed		Southwest Virginia coal field
VA	Williamson coal bed		Southwest Virginia coal field
WV	Williamson Rider coal bed		Tug Fork region
WV	Williamson coal zone		Tug Fork and Kanawha Valley regions
WV	(Peerless coal bed)		Boone County
WV	Alma coal bed		Kanawha Valley region
WV	[Alma coal bed]	Coal by this name is not equivalent in this region	Tug Fork region

APPENDIX 1—CONTINUED

Table A1–6. Campbell Creek/Upper Elkhorn No. 3 coal zone correlative coal-bed and coal-zone names in the central Appalachian Basin coal region, by State.

[Sources: Headlee and Nolting (1940); Huddle and others (1963); Rice (1984); Nolde (1994a,b); Rice and Hiett (1994); Rice, Hiett, and Koozmin (1994); Chesnut (1996, 1997); Blake (1998); Bascombe M. Blake, Jr., West Virginia Geological and Economic Survey, oral commun. (1998); John K. Hiett and Dan O'Canna, Kentucky Department of Mines and Minerals, written commun. (1998); McColloch (1998); Zurowski and Miller (1998).]

State	Name of Coal Beds or Coal Zones (Local mining industry name for coal bed) [Coal bed or coal zone that is not correlative]	Notes	Region, District, Coal Field, or County
KY	bed codes 560010-561999	Kentucky Department of Mines and Minerals	eastern Kentucky coal field
KY	Nosben coal bed		Big Sandy reserve district
KY	Upper Elkhorn No. 3.5 coal bed		Big Sandy reserve district
KY	Elk Gap coal bed		Southwestern reserve district
KY	Lick Fork coal bed		Southwestern reserve district
KY	Verda coal bed		Upper Cumberland River reserve district (Middlesboro and Harlan subdistricts)
KY	Owl coal bed		Upper Cumberland River reserve district (Harlan subdistrict)
KY	"D" coal bed		Upper Cumberland River reserve district (Harlan subdistrict)
KY	Taggart coal zone		Upper Cumberland River reserve district (Harlan subdistrict)
KY	Jack Rock coal bed		Upper Cumberland River reserve district (Middlesboro subdistrict)
KY	Sandstone Parting coal bed		Upper Cumberland River reserve district (Middlesboro subdistrict)
KY	Buckeye Spring coal bed		Upper Cumberland River reserve district (Middlesboro and Harlan subdistricts)
KY	Darby coal bed		Upper Cumberland River reserve district (Harlan subdistrict)
KY	"C" coal bed		Upper Cumberland River reserve district (Harlan subdistrict)
KY	Keokee coal bed		Upper Cumberland River reserve district (Harlan subdistrict)
KY	bed codes 550010-550199	Kentucky Department of Mines and Minerals	eastern Kentucky coal field
KY	Tom Cooper coal bed		Princess and Licking River reserve districts
KY	Van Lear coal bed		Princess, Licking River, and Big Sandy reserve districts
KY	Little Caney coal bed		Princess, Licking River, and Hazard reserve districts
KY	Upper Elkhorn No. 3 coal zone		Licking River, Big Sandy, Hazard, and Southwestern reserve districts
KY	(Elkhorn No. 3 coal bed)	Kentucky Department of Mines and Minerals	Licking River, Big Sandy, Hazard, and Southwestern reserve districts
KY	Nucomb Creek coal bed		Licking River reserve district
KY	Thacker coal zone		Big Sandy reserve district
KY	(Cedar Grove coal bed)	Kentucky Department of Mines and Minerals	eastern Kentucky
KY	Millers Creek coal bed		Big Sandy reserve district
KY	Sidney coal bed		Big Sandy reserve district
KY	Cadell coal bed		Southwestern reserve district
KY	Vanderpool coal zone		Southwestern reserve district
KY	"B" coal bed		Upper Cumberland River reserve district (Harlan subdistrict)
KY	Kellioka coal bed		Upper Cumberland River reserve district (Harlan subdistrict)
KY	Taggart Marker coal bed		Upper Cumberland River reserve district (Harlan subdistrict)
KY	Upper Elkhorn coal zone	Uncertain correlation	eastern Kentucky coal field
TN	Elk Gap coal bed		west of Cumberland overthrust sheet
TN	Lick Fork coal bed		west of Cumberland overthrust sheet
TN	[Jordan coal bed]	Coal by this name is younger and is not equivalent in this region	west of Cumberland overthrust sheet
TN	Jordan coal bed		Cumberland overthrust sheet
TN	Sandstone Parting coal bed		Cumberland overthrust sheet

Table A1–6.—Continued.

State	Name of Coal Beds or Coal Zones (Local mining industry name for coal bed) [Coal bed or coal zone that is not correlative]	Notes	Region, District, Coal Field, or County
VA	[Jack Rock coal bed]	Coal by this name is younger and is not equivalent in this region	Southwest Virginia coal field
VA	"34-inch" coal bed		Southwest Virginia coal field
VA	Low Splint E coal bed		Southwest Virginia coal field
VA	Upper Cedar Grove coal bed		Southwest Virginia coal field
VA	Cedar Grove coal bed		Southwest Virginia coal field
VA	Lower Cedar Grove coal zone		Southwest Virginia coal field
VA	Taggart coal bed		Southwest Virginia coal field
VA	Taggart A, B, C, D, E coal beds		Southwest Virginia coal field
VA	Darby coal bed		Southwest Virginia coal field
VA	Keokee coal bed		Southwest Virginia coal field
VA	Taggart Marker coal bed		Southwest Virginia coal field
VA	"C" coal bed		Southwest Virginia coal field
VA	No. 5 coal bed		Southwest Virginia coal field
VA	[Campbell Creek coal bed]	Coal by this name is older and is not equivalent in this region	Southwest Virginia coal field
WV	Campbell Creek coal zone		Kanawha Valley region
WV	Peerless coal bed		Kanawha Valley region
WV	Lower Campbell Creek coal bed		Kanawha Valley region
WV	No. 2 Gas coal bed		Kanawha Valley region
WV	Upper War Eagle coal bed		Kanawha Valley region
WV	[Cedar Grove coal zone]	Coal by this name is not equivalent in this region	Kanawha Valley region
WV	Upper Cedar Grove coal bed		Tug Fork region
WV	Cedar Grove coal bed		Tug Fork region
WV	Lower Cedar Grove coal bed		Tug Fork region
WV	Thacker coal zone	Name used locally	Tug Fork region
WV	[Campbell Creek coal bed]	Coal by this name is older and is not equivalent in this region	Tug Fork region
WV	[Lower Campbell Creek coal bed]	Coal by this name is older and is not equivalent in this region	Tug Fork region

APPENDIX 1—CONTINUED

Table A1–7. Upper Elkhorn Nos. 1 and 2/Powellton coal zone correlative coal-bed and coal-zone names in the central Appalachian Basin coal region, by State.

[Sources: Headlee and Nolting (1940); Huddle and others (1963); Rice (1984); Nolde (1994a,b); Rice and Hiett (1994); Rice, Hiett, and Koozmin (1994); Chesnut (1996, 1997); Blake (1998); Bascombe M. Blake, Jr., West Virginia Geological and Economic Survey, oral commun. (1998); John K. Hiett and Dan O'Canna, Kentucky Department of Mines and Minerals, written commun. (1998); McColloch (1998); Zurowski and Miller (1998).]

State	Name of Coal Beds or Coal Zones (Local mining industry name for coal bed) [Coal bed or coal zone that is not correlative]	Notes	Region, District, Coal Field, or County
KY	bed codes 540010-541999	Kentucky Department of Mines and Minerals	eastern Kentucky coal field
KY	Upper Elkhorn No. 2 coal bed		Licking River, Big Sandy, and Hazard reserve districts
KY	(Elkhorn No. 2 coal bed)	Kentucky Department of Mines and Minerals	eastern Kentucky coal field
KY	Upper Elkhorn No. 1 coal bed		Big Sandy and Hazard reserve districts
KY	(Elkhorn No. 1 coal bed)	Kentucky Department of Mines and Minerals	eastern Kentucky coal field
KY	Grassy coal zone		Princess, Licking River, and Hazard reserve districts
KY	Hopewell coal bed		Princess reserve district
KY	Lacey Creek coal bed		Licking River, and Big Sandy reserve districts
KY	Alma coal bed		Big Sandy reserve district
KY	Warfield coal bed		Big Sandy reserve district
KY	Upper Jellico coal bed		Southwestern reserve district
KY	Jellico coal zone		Southwestern reserve district
KY	Rim coal bed		Southwestern reserve district
KY	Artemus coal bed		Southwestern reserve district
KY	Beech Creek coal bed		Southwestern reserve district
KY	Moss coal bed		Southwestern reserve district
KY	Huckleberry coal bed		Southwestern reserve district
KY	Lower Jellico coal bed		Southwestern reserve district
KY	Upper Mingo coal bed		Upper Cumberland River reserve district (Middlesboro subdistrict)
KY	Mingo coal bed		Upper Cumberland River reserve district (Middlesboro subdistrict)
KY	Yellow Creek coal bed		Upper Cumberland River reserve district (Middlesboro subdistrict)
KY	Lower Mingo coal bed		Upper Cumberland River reserve district (Middlesboro subdistrict)
KY	Mason coal zone		Upper Cumberland River reserve district (Middlesboro subdistrict)
KY	[Mason coal zone]		Upper Cumberland River reserve district (Harlan subdistrict)
KY	Collier coal bed		Upper Cumberland River reserve district (Harlan subdistrict)
KY	Standiford coal bed	Misspelled as Staniford	Upper Cumberland River reserve district (Harlan subdistrict)
KY	Wilson coal bed		Upper Cumberland River reserve district (Harlan subdistrict)
KY	Harlan coal zone		Upper Cumberland River reserve district (Harlan subdistrict)
KY	"A" coal bed		Upper Cumberland River reserve district (Harlan subdistrict)
TN	Jellico coal zone		on and west of Cumberland overthrust sheet
TN	Mingo coal bed		on and west of Cumberland overthrust sheet
TN	Joyner coal bed		west of Cumberland overthrust sheet
TN	State coal bed	Name used locally	west of Cumberland overthrust sheet
TN	Brushy Mountain coal bed	Name used locally	west of Cumberland overthrust sheet
TN	Big Brushy coal bed	Name used locally	west of Cumberland overthrust sheet
TN	Log Mountain coal bed		Cumberland overthrust sheet
VA	Kirk coal bed		Southwest Virginia coal field
VA	Wilson coal bed		Southwest Virginia coal field
VA	Upper Standiford coal bed		Southwest Virginia coal field
VA	Upper Alma coal bed		Southwest Virginia coal field
VA	Harlan coal bed		Southwest Virginia coal field
VA	Standiford coal bed		Southwest Virginia coal field
VA	Collier coal bed		Southwest Virginia coal field
VA	Upper St. Charles coal bed		Southwest Virginia coal field
VA	No. 2A coal bed		Southwest Virginia coal field
VA	Lower Standiford coal bed		Southwest Virginia coal field
VA	Alma coal bed		Southwest Virginia coal field

Table A1–7.—Continued.

State	Name of Coal Beds or Coal Zones (Local mining industry name for coal bed) [Coal bed or coal zone that is not correlative]	Notes	Region, District, Coal Field, or County
WV	Powellton "A" coal bed		Kanawha Valley region
WV	Powellton Rider coal bed		Kanawha Valley region
WV	Upper Powellton coal bed		Kanawha Valley region
WV	Powellton coal bed		Kanawha Valley region
WV	Brownstown coal bed	Old name, no longer used	Kanawha Valley region
WV	Lower Powellton coal bed		Kanawha Valley region
WV	[Alma coal bed]	Coal by this name is not equivalent in this region	Kanawha Valley region
WV	Alma "A" coal bed		Tug Fork region
WV	Alma Rider coal bed		Tug Fork region
WV	Alma coal bed		Tug Fork region
WV	Little Alma coal bed		Tug Fork region
WV	Warfield coal bed		Tug Fork region

APPENDIX 2

WEST VIRGINIA MINING INDUSTRY COAL-BED NAMES AND THEIR RECORRELATIONS FOR EACH COAL ZONE BY COUNTY

Table A2–1. Coal-bed names, by county, that are used for the No. 5 Block coal zone in the West Virginia Miners Health, Safety, and Training-Safety Information System (WV MHST-SIS) production database from 1982 through 1996, using recorrelations by the West Virginia Geological and Economic Survey (WVGES).

[R, revised correlations in this county; BMB, correlation according to Bascombe M. Blake, Jr., WVGES, oral commun. (1998); zero indicates no production reported for this bed in this county for the years 1982 through 1996.]

County	Coal bed name (WV MHST-SIS)	Coal bed name (WVGES)	Notes	Geographic region
Boone	Middle Kittanning	Upper No. 5 Block		Tug Fork and Kanawha Valley regions
Boone	Lower Kittanning	No. 5 Block		Tug Fork and Kanawha Valley regions
Braxton	Upper Freeport	No. 5 Block	R, BMB	Southern West Virginia
Braxton	Lower Freeport	No. 5 Block	R, BMB	Southern West Virginia
Clay	Middle Kittanning	Upper No. 5 Block		Kanawha Valley region
Clay	Lower Kittanning	No. 5 Block		Kanawha Valley region
Fayette	Middle Kittanning	Upper No. 5 Block		Kanawha Valley region
Fayette	Lower Kittanning	No. 5 Block		Kanawha Valley region
Kanawha	Middle Kittanning	Upper No. 5 Block		Kanawha Valley region
Kanawha	Lower Kittanning	No. 5 Block		Kanawha Valley region
Lincoln	Lower Kittanning	No. 5 Block		Tug Fork region
Logan	Upper Freeport	No. 5 Block	BMB	Tug Fork region
Logan	Middle Kittanning	Upper No. 5 Block		Tug Fork region
Logan	Lower Kittanning	No. 5 Block		Tug Fork region
Mingo	Upper Freeport	No. 5 Block	BMB	Tug Fork region
Mingo	Lower Freeport	No. 5 Block	BMB	Tug Fork region
Mingo	Middle Kittanning	Upper No. 5 Block		Tug Fork region
Mingo	Lower Kittanning	No. 5 Block		Tug Fork region
Nicholas	Mahoning	No. 5 Block	BMB	Kanawha Valley region
Nicholas	Upper Freeport	No. 5 Block	BMB	Kanawha Valley region
Nicholas	Lower Freeport	No. 5 Block	BMB	Kanawha Valley region
Nicholas	Middle Kittanning	Upper No. 5 Block		Kanawha Valley region
Nicholas	Lower Kittanning	No. 5 Block		Kanawha Valley region
Raleigh	Lower Kittanning	No. 5 Block	zero	Kanawha Valley region
Wayne	Lower Kittanning	No. 5 Block		Tug Fork region
Webster	Upper Freeport	No. 5 Block	R, BMB	Southern West Virginia
Webster	Upper Kittanning Rider	No. 5 Block	R, BMB	Southern West Virginia
Wyoming	Lower Kittanning	No. 5 Block		Tug Fork and Kanawha Valley regions

APPENDIX 2—CONTINUED

Table A2–2. Coal-bed names, by county, that are used for the Stockton coal zone in the West Virginia Miners Health, Safety, and Training-Safety Information System (WV MHST-SIS) production database from 1982 through 1996, using recorrelations by the West Virginia Geological and Economic Survey (WVGES).

[R, revised correlations in this county; BMB, correlation according to Bascombe M. Blake, Jr., WVGES, oral commun. (1998); zero indicates no production reported for this bed in this county for the years 1982 through 1996; ?, stratigraphic position of the coal bed is uncertain.]

County	Coal bed name (WV MHST-SIS)	Coal bed name (WVGES)	Notes	Geographic region
Boone	Stockton-Lewiston	Stockton		Tug Fork and Kanawha Valley regions
Braxton	Middle Kittanning	Stockton	R, BMB	Southern West Virginia
Fayette	Stockton-Lewiston	Stockton		Kanawha Valley region
Kanawha	Stockton-Lewiston	Stockton		Kanawha Valley region
Lincoln	Stockton-Lewiston	Stockton	zero	Tug Fork region
Logan	Stockton-Lewiston	Stockton		Tug Fork region
Mingo	Stockton-Lewiston	Stockton		Tug Fork region
Raleigh	Stockton-Lewiston	Stockton	zero	Kanawha Valley region
Upshur	Stockton-Lewiston	Stockton	?, zero	Northern and southern West Virginia
Wayne	Stockton-Lewiston	Stockton		Tug Fork region
Webster	Middle Kittanning	Stockton	R, BMB	Southern West Virginia
Webster	Stockton-Lewiston	Stockton	R, BMB	Southern West Virginia

Table A2–3. Coal-bed names, by county, that are used for the Coalburg coal zone in the West Virginia Miners Health, Safety, and Training-Safety Information System (WV MHST-SIS) production database from 1982 through 1996, using recorrelations by the West Virginia Geological and Economic Survey (WVGES).

[R, revised correlations in this county; BMB, correlation according to Bascombe M. Blake, Jr., WVGES, oral commun. (1998); zero indicates no production reported for this bed in this county for the years 1982 through 1996.]

County	Coal bed name (WV MHST-SIS)	Coal bed name (WVGES)	Notes	Geographic region
Boone	Coalburg	Coalburg		Tug Fork and Kanawha Valley regions
Braxton	Lower Kittanning	Coalburg	R, BMB	Southern West Virginia
Clay	Coalburg	Coalburg		Kanawha Valley region
Fayette	Coalburg	Coalburg		Kanawha Valley region
Kanawha	Coalburg	Coalburg		Kanawha Valley region
Lincoln	Coalburg	Coalburg	zero	Tug Fork region
Logan	Coalburg	Coalburg		Tug Fork region
Mingo	Coalburg	Coalburg		Tug Fork region
Mingo	Little Coalburg	Coalburg		Tug Fork region
Nicholas	Coalburg	Coalburg		Kanawha Valley region
Raleigh	Coalburg	Coalburg	zero	Kanawha Valley region
Wayne	Coalburg	Coalburg		Tug Fork region
Wayne	Winifrede	Coalburg	BMB	Tug Fork region
Webster	Lower Kittanning	Coalburg	R, BMB	Southern West Virginia

APPENDIX 2—CONTINUED

Table A2–4. Coal-bed names, by county, that are used for the Winifrede coal zone in the West Virginia Miners Health, Safety, and Training-Safety Information System (WV MHST-SIS) production database from 1982 through 1996, using recorrelations by the West Virginia Geological and Economic Survey (WVGES).

[R, revised correlations in this county; BMB, correlation according to Bascombe M. Blake, Jr., WVGES, oral commun. (1998).]

County	Coal bed name (WV MHST-SIS)	Coal bed name (WVGES)	Notes	Geographic region
Boone	Buffalo Creek	Upper Winifrede	BMB	Tug Fork and Kanawha Valley regions
Boone	Winifrede	Winifrede		Tug Fork and Kanawha Valley regions
Boone	Lower Winifrede	Lower Winifrede		Tug Fork and Kanawha Valley regions
Braxton	Clarion	Winifrede	R, BMB	Southern West Virginia
Fayette	Winifrede	Winifrede		Kanawha Valley region
Kanawha	Winifrede	Winifrede		Kanawha Valley region
Logan	Buffalo Creek	Upper Winifrede	BMB	Tug Fork region
Logan	Winifrede	Winifrede		Tug Fork region
Logan	Lower Winifrede	Lower Winifrede		Tug Fork region
Mineral	Winifrede	Winifrede		Northern West Virginia
Mingo	Winifrede	Winifrede		Tug Fork region
Nicholas	Winifrede	Winifrede		Kanawha Valley region
Raleigh	Winifrede	Winifrede		Kanawha Valley region
Webster	Clarion	Winifrede	R, BMB	Southern West Virginia
Wyoming	Winifrede	Winifrede		Tug Fork and Kanawha Valley regions

Table A2–5. Coal-bed names, by county, that are used for the Williamson coal zone in the West Virginia Miners Health, Safety, and Training-Safety Information System (WV MHST-SIS) production database from 1982 through 1996, using recorrelations by the West Virginia Geological and Economic Survey (WVGES).

[BMB, correlation according to Bascombe M. Blake, Jr., WVGES, oral commun. (1998); zero indicates no production reported for this bed in this county for the years 1982 through 1996.]

County	Coal bed name (WV MHST-SIS)	Coal bed name (WVGES)	Notes	Geographic region
Boone	Peerless	Williamson	BMB	Tug Fork and Kanawha Valley regions
Fayette	Williamson	Williamson	zero	Kanawha Valley region
Fayette	Alma	Williamson		Kanawha Valley region
Logan	Williamson	Williamson		Tug Fork region
Mingo	Williamson Rider	Williamson Rider	zero	Tug Fork region
Mingo	Williamson	Williamson		Tug Fork region
Nicholas	Williamson	Williamson	zero	Kanawha Valley region
Nicholas	Alma	Williamson	BMB	Kanawha Valley region
Raleigh	Alma	Williamson		Kanawha Valley region
Wyoming	Williamson	Williamson		Tug Fork and Kanawha Valley regions

APPENDIX 2—CONTINUED

Table A2–6. Coal-bed names, by county, that are used for the Campbell Creek coal zone in the West Virginia Miners Health, Safety, and Training-Safety Information System (WV MHST-SIS) production database from 1982 through 1996, using recorrelations by the West Virginia Geological and Economic Survey (WVGES).

[BMB, correlation according to Bascombe M. Blake, Jr., WVGES, oral commun. (1998); zero indicates no production reported for this bed in this county for the years 1982 through 1996; ?, stratigraphic position of the coal bed is uncertain.]

County	Coal bed name (WV MHST-SIS)	Coal bed name (WVGES)	Notes	Geographic region
Barbour	Peerless	Peerless		Northern West Virginia
Boone	Cedar Grove	Peerless	BMB	Tug Fork and Kanawha Valley regions
Boone	Lower Cedar Grove	No. 2 Gas	BMB	Tug Fork and Kanawha Valley regions
Boone	No. 2 Gas	No. 2 Gas		Tug Fork and Kanawha Valley regions
Boone	Lower Campbell Creek	No. 2 Gas		Tug Fork and Kanawha Valley regions
Fayette	Peerless	Peerless		Kanawha Valley region
Fayette	No. 2 Gas	No. 2 Gas		Kanawha Valley region
Kanawha	Peerless	Peerless		Kanawha Valley region
Kanawha	No. 2 Gas	No. 2 Gas		Kanawha Valley region
Logan	Cedar Grove	Peerless		Tug Fork region
Logan	Lower Cedar Grove	No. 2 Gas		Tug Fork region
McDowell	Lower Cedar Grove	No. 2 Gas		Tug Fork region
McDowell	Peerless	Peerless	zero	Tug Fork region
Mingo	Cedar Grove	Peerless		Tug Fork region
Mingo	Lower Cedar Grove	No. 2 Gas		Tug Fork region
Nicholas	Peerless	Peerless		Kanawha Valley region
Nicholas	No. 2 Gas	No. 2 Gas		Kanawha Valley region
Raleigh	Peerless	Peerless		Kanawha Valley region
Raleigh	No. 2 Gas	No. 2 Gas		Kanawha Valley region
Randolph	Peerless	Peerless	?	Northern and Southern West Virginia
Wayne	No. 2 Gas	No. 2 Gas	?	Tug Fork region
Webster	Peerless	Peerless		Southern West Virginia
Wyoming	Cedar Grove	Peerless		Tug Fork and Kanawha Valley regions
Wyoming	Lower Cedar Grove	No. 2 Gas		Tug Fork and Kanawha Valley regions
Wyoming	Peerless	Peerless		Tug Fork and Kanawha Valley regions
Wyoming	No. 2 Gas	No. 2 Gas		Tug Fork and Kanawha Valley regions

Table A2–7. Coal-bed names, by county, that are used for the Powellton coal zone in the West Virginia Miners Health, Safety, and Training-Safety Information System (WV MHST-SIS) production database from 1982 through 1996, using recorrelations by the West Virginia Geological and Economic Survey (WVGES).

[BMB, correlation according to Bascombe M. Blake, Jr., WVGES, oral commun. (1998); zero indicates no production reported for this bed in this county for the years 1982 through 1996.]

County	Coal bed name (WV MHST-SIS)	Coal bed name (WVGES)	Notes	Geographic region
Boone	Alma	Powellton	BMB	Tug Fork and Kanawha Valley regions
Boone	Powellton	Powellton		Tug Fork and Kanawha Valley regions
Fayette	Powellton A	Powellton A	zero	Kanawha Valley region
Fayette	Powellton	Powellton		Kanawha Valley region
Kanawha	Powellton	Powellton	zero	Kanawha Valley region
Lincoln	Alma	Powellton	zero	Tug Fork region
Logan	Alma A	Powellton		Tug Fork region
Logan	Alma	Powellton		Tug Fork region
McDowell	Alma	Powellton		Tug Fork region
Mingo	Alma A	Powellton		Tug Fork region
Mingo	Alma	Powellton		Tug Fork region
Mingo	Little Alma	Lower Powellton	BMB	Tug Fork region
Raleigh	Powellton	Powellton		Kanawha Valley region
Wayne	Alma	Powellton		Tug Fork region
Wyoming	Alma	Powellton		Tug Fork and Kanawha Valley regions
Wyoming	Powellton	Powellton		Tug Fork and Kanawha Valley regions

APPENDIX 3

COAL-RESOURCE DATABASE FOR THE ESTIMATED COAL RESOURCES BY STATE, COUNTY, COAL-BED NAME, THICKNESS CATEGORY, AND RELIABILITY CATEGORY FOR COAL IN THE NO. 5 BLOCK, STOCKTON AND COALBURG, WINIFREDE/HAZARD, WILLIAMSON/AMBURGY, CAMPBELL CREEK/UPPER ELKHORN NO. 3, AND UPPER ELKHORN NOS. 1 AND 2/POWELLTON COAL ZONES, REMAINING IN THE GROUND AS OF JANUARY 1, 1974

[Data are from the USCOAL coal resources database (U.S. Geological Survey, 1997; also available on the web at http://energy.er.usgs.gov/coalres.htm) and were used to compile the information presented in Appendix 4 (tables A4–1 through A4–6), Appendix 5 (tables A5–1 through A5–6), and Appendix 6 (tables A6–1 through A6–6). Asterisk indicates column added for this report.]

CLICK HERE TO GO TO APPENDIX 3

The following is an explanation of the headings in electronic file CHAP_I_APPENDIX3.csv:

Headings in CHAP_I_APPENDIX3.csv	Headings in USCOAL database	Explanation
State	statecd	Name of State where sample was collected.
County	cnty	Name of county within State where sample was collected.
Coal Province	cprov	Coal province name.
Coal Region	cregn	Coal region name, a subset of coal province.
Coal Field	cfield	Coal field name as given in the source document.
District	dist	Local mining district name.
Map	map	7.5-minute topographic quadrangle (or other map) in which the resource tonnage estimate was made.
System	sys	Geologic age designation.
Series	sere	Subdivision of a system.
Formation	cform	Stratigraphic formation name.
Coal-Bed Name	cbed	Coal bed name listed in USCOAL database (U.S. Geological Survey, 1997).
Coal-Zone Name		Name of equivalent coal zone, used in this report.*
Code (This Report)		Numerical code for coal zone, used in this report.*
Major Rank	majrank	Rank of coal (anthracite, bituminous, subbituminous, or lignite).
Data Source	srce	Abbreviation of the publication from which the data were taken. See the reference documentation in USCOAL database (U.S. Geological Survey, 1997) and the following publications: Headlee and Nolting (1940), Brown and others (1952), Dowd and others (1952), Wallace and others (1953, 1954), Tavenner and others (1956), Luther (1959), and Huddle and others (1963).
Year	yr	Year of publication of the source document.
Base Year	byr	Base year for which estimates of coal tonnage were made.
Thickness_in	thk	Range of coal thickness category (in inches).
Thickness_ft	thk	Range of coal thickness category (converted to feet).
Overburden	obdn	Range of overburden thickness category.
Reliability	reliabl	Reliability of a tonnage estimate based upon its proximity to a coal-thickness measurement data point.
Tonnage	ton	Estimated coal resource (in millions of short tons, to two decimal places).
Data Order		Indicates line number in database.*

APPENDIX 4

ESTIMATED COAL RESOURCES BY STATE, COAL-BED OR COAL-ZONE NAME, AND THICKNESS CATEGORY, FOR EACH COAL ZONE, REMAINING IN THE GROUND AS OF JANUARY 1, 1974 (IN MILLIONS OF SHORT TONS)

[Data are compiled from Appendix 3. Source: USCOAL coal resources database (U.S. Geological Survey, 1997; also available on the web at http://energy.er.usgs.gov/coalres.htm).]

Table A4–1. Estimated coal resources for the No. 5 Block coal zone by State, coal-bed or coal-zone name, and thickness category, remaining in the ground as of January 1, 1974 (in millions of short tons).

[Data are compiled from Appendix 3. Coal-bed or coal-zone name is entered as it appears in the USCOAL coal resource database (U.S. Geological Survey, 1997). na, not applicable; nd, no data available. Source: USCOAL coal resources database (U.S. Geological Survey, 1997; also available on the web at http://energy.er.usgs.gov/coalres.htm), which was searched for resource data for all coal-bed and coal-zone names that are listed for the No. 5 Block coal zone in Appendix 1 (table A1–1). Geographic range restrictions were applied to the database search.]

State	Coal-bed or coal-zone name	Thickness categories					Percent of total
		1.17 to 2.33 feet	>2.33 to 3.50 feet	>3.50 feet	Unclassified	Total	
ALL	na	150	160	350	6,500	7,200	100
KY	na	140	140	170	nd	450	6.3
WV	na	5.7	22	180	6,500	6,700	94
KY	Princess No. 5	100	73	17	nd	190	2.7
KY	Richardson	38	63	120	nd	220	3.1
KY	Skyline	1.3	7.4	28	nd	37	0.51
WV	Lower Freeport	nd	nd	nd	75	75	1.1
WV	Lower Kittanning	nd	nd	nd	1,200	1,200	17
WV	Middle Kittanning	nd	nd	nd	570	570	8.0
WV	No. 5 Block	5.7	22	180	4,300	4,500	63
WV	Upper Freeport	nd	nd	nd	340	340	4.7
WV	Upper No. 5 Block	nd	0.08	0.89	nd	0.97	0.014

APPENDIX 4—CONTINUED

Table A4–2. Estimated coal resources for the Stockton and Coalburg coal zone by State, coal-bed or coal-zone name, and thickness category, remaining in the ground as of January 1, 1974 (in millions of short tons).

[Data are compiled from Appendix 3. Coal-bed or coal-zone name is entered as it appears in the USCOAL coal resource database (U.S. Geological Survey, 1997). na, not applicable; nd, no data available. Source: USCOAL coal resources database (U.S. Geological Survey, 1997; also available on the web at http://energy.er.usgs.gov/coalres.htm), which was searched for resource data for all coal-bed and coal-zone names that are listed for the Stockton and Coalburg coal zone in Appendix 1 (tables A1–2 and A2–3). Geographic range restrictions were applied to the database search.]

State	Coal-bed or coal-zone name	Thickness categories					Percent of total
		1.17 to 2.33 feet	>2.33 to 3.50 feet	>3.50 feet	Unclassified	Total	
ALL	na	1,000	1,300	2,800	6,800	12,000	100
KY	na	860	1,000	2,100	nd	4,000	33
VA	na	0.91	16	12	nd	29	0.24
WV	na	150	220	700	6,800	7,900	66
KY	Francis	82	150	190	nd	430	3.6
KY	Fugate	38	23	11	nd	71	0.60
KY	Hazard No. 7	230	370	890	nd	1,500	13
KY	High Splint	2.8	11	150	nd	170	1.4
KY	Hindman	46	69	240	nd	350	3.0
KY	Nickell	8.3	1.4	nd	nd	9.7	0.081
KY	Oakley	74	75	8.6	nd	160	1.3
KY	Peach Orchard	120	210	330	nd	650	5.5
KY	Princess No. 3	170	32	1.5	nd	200	1.7
KY	Princess No. 4	57	13	1.0	nd	71	0.60
KY	Torchlight	35	80	250	nd	360	3.0
VA	High Splint	0.91	16	12	nd	29	0.24
WV	Coalburg	110	120	530	2,300	3,100	26
WV	Little Coalburg	3.9	3.7	3.7	nd	11	0.095
WV	Middle Kittanning	nd	nd	nd	320	320	2.7
WV	Stockton-Lewiston	34	89	170	4,200	4,500	38

APPENDIX 4—CONTINUED

Table A4–3. Estimated coal resources for the Winifrede/Hazard coal zone by State, coal-bed or coal-zone name, and thickness category, remaining in the ground as of January 1, 1974 (in millions of short tons).

[Data are compiled from Appendix 3. Coal-bed or coal-zone name is entered as it appears in the USCOAL coal resource database (U.S. Geological Survey, 1997). na, not applicable; nd, no data available. Source: USCOAL coal resources database (U.S. Geological Survey, 1997; also available on the web at http://energy.er.usgs.gov/coalres.htm), which was searched for resource data for all coal-bed and coal-zone names that are listed for the Winifrede/Hazard coal zone in Appendix 1 (table A1–4). Geographic range restrictions were applied to the database search.]

State	Coal-bed or coal-zone name	Thickness categories					Percent of total
		1.17 to 2.33 feet	>2.33 to 3.50 feet	>3.50 feet	Unclassified	Total	
ALL	na	1,100	1,400	750	2,600	5,900	100
KY	na	860	1,100	530	nd	2,500	43
TN	na	nd	65	13	nd	78	1.3
VA	na	2.7	6.6	22	nd	32	0.53
WV	na	260	190	190	2,600	3,300	55
KY	Adele	1.5	0.12	nd	nd	1.6	0.028
KY	Colvin	27	1.6	nd	nd	29	0.49
KY	Haddix	330	380	130	nd	850	14
KY	Hazard	340	620	350	nd	1,300	22
KY	Index	150	130	35	nd	310	5.2
KY	Prater	10	8.4	0.37	nd	19	0.32
KY	Red Springs	nd	2.8	9.0	nd	12	0.20
TN	Hazard No. 5A	nd	19	6.4	nd	25	0.43
TN	Pewee	nd	46	6.7	nd	52	0.90
VA	Morris	2.7	6.6	22	nd	32	0.53
WV	Buffalo Creek	100	85	62	nd	250	4.2
WV	Lower Winifrede	nd	nd	9.6	nd	9.6	0.16
WV	Winifrede	160	110	120	2,600	3,000	51

APPENDIX 4—CONTINUED

Table A4–4. Estimated coal resources for the Williamson/Amburgy coal zone by State, coal-bed or coal-zone name, and thickness category, remaining in the ground as of January 1, 1974 (in millions of short tons).

[Data are compiled from Appendix 3. Coal-bed or coal-zone name is entered as it appears in the USCOAL coal resource database (U.S. Geological Survey, 1997). na, not applicable; nd, no data available. Source: USCOAL coal resources database (U.S. Geological Survey, 1997; also available on the web at http://energy.er.usgs.gov/coalres.htm), which was searched for resource data for all coal-bed and coal-zone names that are listed for the Williamson/Amburgy coal zone in Appendix 1 (table A1–5). Geographic range restrictions were applied to the database search.]

State	Coal-bed or coal-zone name	Thickness categories					Percent of total
		1.17 to 2.33 feet	>2.33 to 3.50 feet	>3.50 feet	Unclassified	Total	
ALL	na	1,300	1,200	480	1,600	4,600	100
KY	na	930	890	370	nd	2,200	48
TN	na	nd	54	0.29	nd	54	1.2
VA	na	55	45	21	nd	120	2.6
WV	na	270	240	88	1,600	2,200	48
KY	Amburgy	510	630	27	nd	1,200	26
KY	Gun Creek	190	47	nd	nd	240	5.2
KY	Low Splint	13	66	52	nd	130	2.8
KY	Mills	39	6.4	nd	nd	45	nd
KY	Poplar Lick	0.16	10	93	nd	100	2.2
KY	Sterling	0.71	3.7	20	nd	25	0.54
KY	Williamson	170	130	180	nd	480	10
TN	Jordan	nd	15	nd	nd	15	0.32
TN	Pioneer	nd	39	0.29	nd	39	0.86
VA	Low Splint	55	45	21	nd	120	2.6
WV	Alma	nd	4.7	37	1,600	1,600	35
WV	Williamson	270	240	51	45	600	13

APPENDIX 4—CONTINUED

Table A4–5. Estimated coal resources for the Campbell Creek/Upper Elkhorn No. 3 coal zone by State, coal-bed or coal-zone name, and thickness category, remaining in the ground as of January 1, 1974 (in millions of short tons).

[Data are compiled from Appendix 3. Coal-bed or coal-zone name is entered as it appears in the USCOAL coal resource database (U.S. Geological Survey, 1997). na, not applicable; nd, no data available. Source: USCOAL coal resources database (U.S. Geological Survey, 1997; also available on the web at http://energy.er.usgs.gov/coalres.htm), which was searched for resource data for all coal-bed and coal-zone names that are listed for the Campbell Creek/Upper Elkhorn No. 3 coal zone in Appendix 1 (table A1–6). Geographic range restrictions were applied to the database search.]

State	Coal-bed or coal-zone name	Thickness categories					Percent of total
		1.17 to 2.33 feet	>2.33 to 3.50 feet	>3.50 feet	Unclassified	Total	
ALL	na	1,700	3,100	2,500	5,900	13,000	100
KY	na	1,300	2,200	970	nd	4,500	34
VA	na	53	160	96	nd	310	2.3
WV	na	350	690	1,500	5,900	8,400	63
KY	"D"	8.4	90	24	nd	120	0.93
KY	Darby	52	270	95	nd	420	3.1
KY	Kellioka	72	61	4.7	nd	140	1.0
KY	Sandstone Parting	3.7	67	1.5	nd	72	0.55
KY	Tom Cooper	450	210	9.0	nd	670	5.1
KY	Upper Elkhorn No. 3	760	1,500	840	nd	3,100	24
VA	"C"	7.5	11	nd	nd	18	0.14
VA	Cedar Grove	nd	nd	3.8	nd	3.8	0.029
VA	Lower Cedar Grove	1.1	nd	1.1	nd	2.3	0.017
VA	Taggart	3.4	74	91	nd	170	1.3
VA	Taggart Marker	41	77	nd	nd	120	0.89
WV	Campbell Creek	5.1	91	320	5,900	6,300	48
WV	Cedar Grove	120	270	1,000	3.3	1,400	11
WV	Lower Cedar Grove	97	180	82	3.6	360	2.7
WV	Upper Cedar Grove	120	150	61	nd	330	2.5

APPENDIX 4—CONTINUED

Table A4–6. Estimated coal resources for the Upper Elkhorn Nos. 1 and 2/Powellton coal zone by State, coal-bed or coal-zone name, and thickness category, remaining in the ground as of January 1, 1974 (in millions of short tons).

[Data are compiled from Appendix 3. Coal-bed or coal-zone name is entered as it appears in the USCOAL coal resource database (U.S. Geological Survey, 1997). na, not applicable; nd, no data available. Source: USCOAL coal resources database (U.S. Geological Survey, 1997; also available on the web at http://energy.er.usgs.gov/coalres.htm), which was searched for resource data for all coal-bed and coal-zone names that are listed for the Upper Elkhorn Nos. 1 and 2/Powellton coal zone in Appendix 1 (table A1–7). Geographic range restrictions were applied to the database search.]

State	Coal-bed or coal-zone name	Thickness categories					Percent of total
		1.17 to 2.33 feet	>2.33 to 3.50 feet	>3.50 feet	Unclassified	Total	
ALL	na	2,400	3,500	1,700	580	8,200	100
KY	na	2,000	2,600	1,100	nd	5,700	70
TN	na	nd	130	12	nd	140	1.8
VA	na	59	100	37	nd	200	2.4
WV	na	340	680	550	580	2,100	26
KY	Collier	130	270	71	nd	470	5.7
KY	Grassy	150	27	nd	nd	180	2.2
KY	Harlan	100	240	340	nd	680	8.2
KY	Jellico	230	450	31	nd	720	8.7
KY	Lower Split of Harlan	50	44	24	nd	120	1.4
KY	Mingo	10	78	53	nd	140	1.7
KY	Moss	150	120	9.6	nd	280	3.4
KY	Upper Elkhorn No. 1	570	640	160	nd	1,400	17
KY	Upper Elkhorn No. 2	590	750	450	nd	1,800	22
TN	Jellico	nd	91	11	nd	100	1.2
TN	Joyner	nd	41	0.69	nd	42	0.51
VA	Harlan	0.46	86	31	nd	120	1.4
VA	Kirk	1.8	nd	nd	nd	1.8	0.021
VA	Upper St. Charles	3.0	3.7	nd	nd	6.7	0.081
VA	Upper Standiford	54	11	5.8	nd	70	0.86
WV	Alma	310	620	520	50	1,500	18
WV	Alma "A"	4.3	8.9	5.0	nd	18	0.22
WV	Powellton	31	52	20	530	630	7.6
WV	Upper Powellton	nd	2.3	1.8	nd	4.0	0.049

APPENDIX 5

ESTIMATED COAL RESOURCES BY STATE, COUNTY, AND THICKNESS CATEGORY, FOR EACH COAL ZONE, REMAINING IN THE GROUND AS OF JANUARY 1, 1974 (IN MILLIONS OF SHORT TONS)

[Data are compiled from Appendix 3. Source: USCOAL coal resources database (U.S. Geological Survey, 1997; also available on the web at http://energy.er.usgs.gov/coalres.htm).]

Table A5–1. Estimated coal resources of the No. 5 Block coal zone by State, county, and thickness category, remaining in the ground as of January 1, 1974 (in millions of short tons).

[Data are compiled from Appendix 3. na, not applicable; nd, no data available. USCOAL coal resources database (U.S. Geological Survey, 1997; also available on the web at http://energy.er.usgs.gov/coalres.htm).]

State	County	Thickness categories					Percent of total
		1.17 to 2.33 feet	>2.33 to 3.50 feet	>3.50 feet	Unclassified	Total	
ALL	na	150	160	350	6,500	7,200	100
KY	na	140	140	170	nd	450	6.3
WV	na	5.7	22	180	6,500	6,700	94
KY	Boyd	32	28	2.3	nd	62	0.86
KY	Breathitt	0.30	5.1	19	nd	24	0.34
KY	Carter	52	37	14	nd	100	1.4
KY	Elliott	4.1	2.4	3.2	nd	9.7	0.14
KY	Floyd	nd	nd	10	nd	10	0.15
KY	Greenup	18	7.9	0.67	nd	26	0.37
KY	Johnson	nd	nd	10	nd	10	0.14
KY	Knott	nd	0.28	0.56	nd	0.84	0.012
KY	Lawrence	34	59	31	nd	120	1.7
KY	Magoffin	0.96	2.0	8.7	nd	12	0.16
KY	Martin	nd	1.7	58	nd	60	0.84
KY	Morgan	nd	nd	8.9	nd	8.9	0.12
KY	Pike	nd	nd	0.42	nd	0.42	0.0059
WV	Boone	nd	nd	nd	320	320	4.5
WV	Braxton	nd	nd	nd	990	990	14
WV	Brooke	nd	nd	nd	50	50	0.70
WV	Clay	nd	nd	nd	970	970	14
WV	Fayette	nd	nd	nd	72	72	1.0
WV	Kanawha	nd	nd	nd	1,200	1,200	17
WV	Lincoln	nd	nd	nd	690	690	9.7
WV	Logan	5.1	19	160	nd	180	2.6
WV	Mingo	0.61	2.3	3.9	nd	6.8	0.095
WV	Nicholas	nd	nd	nd	870	870	12
WV	Raleigh	nd	0.08	14	nd	14	0.20
WV	Roane	nd	nd	nd	220	220	3.1
WV	Wayne	nd	nd	nd	640	640	8.9
WV	Webster	nd	nd	nd	450	450	6.3
WV	Wyoming	nd	nd	2.9	nd	2.9	0.040

APPENDIX 5—CONTINUED

Table A5–2. Estimated coal resources of the Stockton and Coalburg coal zone by State, county, and thickness category, remaining in the ground as of January 1, 1974 (in millions of short tons).

[Data are compiled from Appendix 3. na, not applicable; nd, no data available. Source: USCOAL coal resources database (U.S. Geological Survey, 1997; also available on the web at http://energy.er.usgs.gov/coalres.htm).]

State	County	Thickness categories					Percent of total
		1.17 to 2.33 feet	>2.33 to 3.50 feet	>3.50 feet	Unclassified	Total	
ALL	na	1,000	1,300	2,800	6,800	12,000	100
KY	na	860	1,000	2,100	nd	4,000	33
VA	na	0.91	16	12	nd	29	0.24
WV	na	150	220	700	6,800	7,900	66
KY	Bell	0.25	0.61	2.8	nd	3.7	0.031
KY	Boyd	26	3.6	nd	nd	30	0.25
KY	Breathitt	150	150	270	nd	580	4.8
KY	Carter	74	15	nd	nd	89	0.75
KY	Clay	0.11	1.0	4.4	nd	5.5	0.046
KY	Elliott	0.12	1.2	nd	nd	1.3	0.011
KY	Floyd	0.42	19	4.9	nd	25	0.21
KY	Greenup	130	26	2.5	nd	160	1.3
KY	Harlan	11	23	170	nd	210	1.8
KY	Johnson	2.3	12	43	nd	57	0.48
KY	Knott	30	150	330	nd	510	4.3
KY	Knox	0.31	0.61	0.92	nd	1.8	0.015
KY	Lawrence	110	56	28	nd	200	1.7
KY	Leslie	100	110	110	nd	320	2.7
KY	Letcher	4.1	8.3	18	nd	30	0.26
KY	Magoffin	100	93	20	nd	220	1.8
KY	Martin	29	160	420	nd	610	5.1
KY	Morgan	19	5.7	nd	nd	25	0.21
KY	Perry	57	150	560	nd	760	6.4
KY	Pike	6.9	35	79	nd	120	1.0
KY	Wolfe	6.8	0.91	nd	nd	7.7	0.065
VA	Lee	nd	0.84	nd	nd	0.84	0.0071
VA	Wise	0.91	15	12	nd	28	0.24
WV	Boone	nd	nd	nd	860	860	7.3
WV	Braxton	nd	nd	nd	240	240	2.0
WV	Clay	nd	nd	nd	1,000	1,000	8.6
WV	Fayette	nd	nd	nd	190	190	1.6
WV	Kanawha	nd	nd	nd	1,900	1,900	16
WV	Lincoln	nd	nd	nd	410	410	3.4
WV	Logan	130	180	250	nd	560	4.7
WV	Mingo	17	31	440	nd	480	4.1
WV	Nicholas	nd	nd	nd	910	910	7.7
WV	Raleigh	0.16	4.1	10	nd	15	0.12
WV	Randolph	nd	nd	nd	34	34	0.29
WV	Roane	nd	nd	nd	130	130	1.1
WV	Upshur	nd	nd	nd	95	95	0.80
WV	Wayne	nd	nd	nd	100	100	0.88
WV	Webster	nd	nd	nd	960	960	8.0
WV	Wyoming	1.7	2.2	1.6	nd	5.5	0.046

APPENDIX 5—CONTINUED

Table A5–3. Estimated coal resources of the Winifrede/Hazard coal zone by State, county, and thickness category, remaining in the ground as of January 1, 1974 (in millions of short tons).

[Data are compiled from Appendix 3. na, not applicable; nd, no data available. Source: USCOAL coal resources database (U.S. Geological Survey, 1997; also available on the web at http://energy.er.usgs.gov/coalres.htm).]

State	County	Thickness categories					Percent of total
		1.17 to 2.33 feet	>2.33 to 3.50 feet	>3.50 feet	Unclassified	Total	
ALL	na	1,100	1,400	750	2,600	5,900	100
KY	na	860	1100	530	nd	2,500	43
TN	na	nd	65	13	nd	78	1.3
VA	na	2.7	6.6	22	nd	32	0.53
WV	na	260	190	190	2,600	3,300	55
KY	Bell	nd	2.8	9.0	nd	12	0.20
KY	Breathitt	290	160	30	nd	480	8.1
KY	Clay	23	13	21	nd	57	0.97
KY	Elliott	32	31	4.7	nd	68	1.1
KY	Floyd	nd	7.0	4.9	nd	12	0.20
KY	Harlan	0.58	85	22	nd	110	1.8
KY	Johnson	4.9	47	36	nd	87	1.5
KY	Knott	58	75	16	nd	150	2.5
KY	Leslie	120	200	76	nd	400	6.7
KY	Letcher	1.8	23	71	nd	96	1.6
KY	Magoffin	74	64	31	nd	170	2.9
KY	Martin	51	120	19	nd	190	3.2
KY	Morgan	71	42	nd	nd	110	1.9
KY	Perry	130	260	180	nd	570	9.6
KY	Pike	4.7	13	11	nd	28	0.48
KY	Wolfe	0.93	0.12	nd	nd	1.1	0.018
TN	Anderson	nd	9.6	1.7	nd	11	0.19
TN	Campbell	nd	40	7.0	nd	47	0.80
TN	Claiborne	nd	1.7	1.5	nd	3.1	0.053
TN	Morgan	nd	5.4	nd	nd	5.4	0.091
TN	Scott	nd	8.0	3.0	nd	11	0.19
VA	Lee	nd	2.7	0.040	nd	2.8	0.047
VA	Wise	2.7	3.8	22	nd	29	0.49
WV	Boone	nd	nd	nd	1,300	1,300	21
WV	Clay	nd	nd	nd	190	190	3.1
WV	Fayette	nd	nd	nd	100	100	1.7
WV	Kanawha	nd	nd	nd	260	260	4.5
WV	Logan	230	150	69	nd	450	7.6
WV	Mingo	30	38	32	nd	99	1.7
WV	Nicholas	nd	nd	nd	390	390	6.5
WV	Preston	nd	nd	nd	30	30	0.51
WV	Raleigh	nd	nd	58	nd	58	0.98
WV	Randolph	nd	nd	nd	36	36	0.60
WV	Upshur	nd	nd	nd	60	60	1.0
WV	Webster	nd	nd	nd	290	290	5.0
WV	Wyoming	1.9	3.6	31	nd	37	0.63

APPENDIX 5—CONTINUED

Table A5–4. Estimated coal resources of the Williamson/Amburgy coal zone by State, county, and thickness category, remaining in the ground as of January 1, 1974 (in millions of short tons).

[Data are compiled from Appendix 3. na, not applicable; nd, no data available. Source: USCOAL coal resources database (U.S. Geological Survey, 1997; also available on the web at http://energy.er.usgs.gov/coalres.htm).]

State	County	Thickness categories					Percent of total
		1.17 to 2.33 feet	>2.33 to 3.50 feet	>3.50 feet	Unclassified	Total	
ALL	na	1,300	1,200	480	1,600	4,600	100
KY	na	930	890	370	nd	2,200	48
TN	na	nd	54	0.29	nd	54	1.2
VA	na	55	45	21	nd	120	2.6
WV	na	270	240	88	1,600	2,200	48
KY	Bell	0.87	14	110	nd	130	2.8
KY	Breathitt	45	51	nd	nd	96	2.1
KY	Carter	13	nd	nd	nd	13	0.28
KY	Clay	4.1	nd	nd	nd	4.1	0.090
KY	Elliott	7.3	0.20	nd	nd	7.5	0.16
KY	Floyd	13	3.1	9.0	nd	25	0.55
KY	Greenup	13	2.3	nd	nd	16	0.34
KY	Harlan	18	62	41	nd	120	2.6
KY	Johnson	8.6	nd	nd	nd	8.6	0.19
KY	Knott	110	110	nd	nd	220	4.8
KY	Knox	35	6.4	nd	nd	41	0.90
KY	Leslie	87	110	nd	nd	190	4.2
KY	Letcher	170	110	38	nd	310	6.9
KY	Magoffin	110	9.1	nd	nd	120	2.6
KY	Martin	5.8	27	nd	nd	33	0.71
KY	Morgan	31	21	nd	nd	53	1.1
KY	Perry	97	260	nd	nd	360	7.9
KY	Pike	150	100	170	nd	410	9.0
KY	Wolfe	17	14	nd	nd	31	0.67
TN	Campbell	nd	29	nd	nd	29	0.64
TN	Claiborne	nd	13	nd	nd	13	0.28
TN	Scott	nd	12	0.29	nd	12	0.26
VA	Lee	2.3	2.7	16	nd	21	0.47
VA	Wise	53	43	4.4	nd	100	2.2
WV	Boone	nd	nd	nd	1,200	1,200	27
WV	Fayette	nd	nd	nd	200	200	4.3
WV	Logan	180	130	10	nd	320	6.9
WV	McDowell	nd	nd	nd	0.84	0.84	0.018
WV	Mingo	90	97	40	nd	230	4.9
WV	Nicholas	nd	nd	nd	140	140	3.2
WV	Raleigh	nd	4.7	37	nd	41	0.9
WV	Webster	nd	nd	nd	46	46	1.0
WV	Wyoming	2.0	7.5	1.4	nd	11	0.24

APPENDIX 5—CONTINUED

Table A5–5. Estimated coal resources of the Campbell Creek/Upper Elkhorn No. 3 coal zone by State, county, and thickness category, remaining in the ground as of January 1, 1974 (in millions of short tons).

[Data are compiled from Appendix 3. na, not applicable; nd, no data available. Source: USCOAL coal resources database (U.S. Geological Survey, 1997; also available on the web at http://energy.er.usgs.gov/coalres.htm).]

State	County	Thickness categories					Percent of total
		1.17 to 2.33 feet	>2.33 to 3.50 feet	>3.50 feet	Unclassified	Total	
ALL	na	1,700	3,100	2,500	5,900	13,000	100
KY	na	1,300	2,200	970	nd	4,500	34
VA	na	53	160	96	nd	310	2.3
WV	na	350	690	1,500	5,900	8,400	63
KY	Bell	3.7	67	1.5	nd	72	0.55
KY	Breathitt	130	37	4.8	nd	170	1.3
KY	Carter	72	48	8.0	nd	130	0.97
KY	Elliott	57	48	nd	nd	100	0.79
KY	Floyd	140	470	120	nd	730	5.5
KY	Greenup	30	0.87	nd	nd	31	0.23
KY	Harlan	120	400	120	nd	640	4.9
KY	Johnson	130	250	8.4	nd	390	2.9
KY	Knott	90	360	120	nd	560	4.2
KY	Lawrence	11	2.0	nd	nd	13	0.096
KY	Leslie	25	30	nd	nd	54	0.41
KY	Letcher	79	130	310	nd	530	4.0
KY	Magoffin	150	45	1.0	nd	190	1.5
KY	Martin	nd	17	46	nd	63	0.47
KY	Morgan	100	57	nd	nd	160	1.2
KY	Perry	39	42	nd	nd	82	0.61
KY	Pike	140	210	230	nd	580	4.4
KY	Wolfe	30	14	nd	nd	43	0.33
VA	Buchanan	1.1	nd	4.9	nd	6.1	0.046
VA	Lee	27	41	11	nd	79	0.60
VA	Tazewell	7.5	11	nd	nd	18	0.14
VA	Wise	18	110	80	nd	210	1.6
WV	Boone	nd	nd	nd	1,500	1,500	11
WV	Calhoun	nd	nd	nd	130	130	0.95
WV	Clay	nd	nd	nd	120	120	0.88
WV	Fayette	nd	nd	nd	770	770	5.8
WV	Kanawha	nd	nd	nd	1,500	1,500	11
WV	Logan	180	350	500	nd	1,000	7.8
WV	McDowell	nd	nd	nd	6.9	6.9	0.052
WV	Mingo	160	230	570	nd	950	7.2
WV	Nicholas	nd	nd	nd	930	930	7.0
WV	Raleigh	4.0	54	270	nd	330	2.5
WV	Randolph	nd	nd	nd	320	320	2.4
WV	Roane	nd	nd	nd	42	42	0.32
WV	Upshur	nd	nd	nd	140	140	1.0
WV	Webster	nd	nd	nd	520	520	4.0
WV	Wyoming	8.0	61	120	nd	190	1.4

APPENDIX 5—CONTINUED

Table A5–6. Estimated coal resources of the Upper Elkhorn Nos. 1 and 2/Powellton coal zone by State, county, and thickness category, remaining in the ground as of January 1, 1974 (in millions of short tons).

[Data are compiled from Appendix 3. na, not applicable; nd, no data available. Source: USCOAL coal resources database (U.S. Geological Survey, 1997; also available on the web at http://energy.er.usgs.gov/coalres.htm).]

State	County	Thickness categories					Percent of total
		1.17 to 2.33 feet	>2.33 to 3.50 feet	>3.50 feet	Unclassified	Total	
ALL	na	2,400	3,500	1,700	580	8,200	100
KY	na	2,000	2,600	1,100	nd	5,700	70
TN	na	nd	130	12	nd	140	1.8
VA	na	59	100	37	nd	200	2.4
WV	na	340	680	550	580	2,100	26
KY	Bell	42	230	95	nd	370	4.5
KY	Breathitt	18	2.1	nd	nd	20	0.25
KY	Carter	15	nd	nd	nd	15	0.19
KY	Clay	110	74	nd	nd	180	2.2
KY	Elliott	28	27	nd	nd	54	0.66
KY	Floyd	240	490	140	nd	870	11
KY	Greenup	7.2	nd	nd	nd	7.2	0.088
KY	Harlan	270	540	400	nd	1,200	15
KY	Johnson	22	6.5	nd	nd	29	0.35
KY	Knott	230	140	21	nd	390	4.8
KY	Knox	180	170	26	nd	380	4.6
KY	Laurel	3.2	11	1.9	nd	16	0.19
KY	Lee	0.08	1.5	nd	nd	1.6	0.019
KY	Letcher	170	21	0.45	nd	190	2.3
KY	Magoffin	64	28	nd	nd	92	1.1
KY	McCreary	8.0	1.6	nd	nd	9.6	0.12
KY	Morgan	74	nd	nd	nd	74	0.91
KY	Owsley	nd	1.4	nd	nd	1.4	0.017
KY	Pike	440	700	450	nd	1,600	19
KY	Whitley	51	160	3.9	nd	210	2.6
KY	Wolfe	13	0.58	nd	nd	13	0.16
TN	Anderson	nd	25	5.6	nd	31	0.37
TN	Campbell	nd	62	0.86	nd	63	0.77
TN	Claiborne	nd	14	5.3	nd	19	0.23
TN	Morgan	nd	27	0.14	nd	27	0.32
TN	Scott	nd	5.2	nd	nd	5.2	0.064
VA	Lee	5.3	90	31	nd	130	1.5
VA	Wise	54	11	5.8	nd	70	0.86
WV	Boone	nd	nd	nd	100	100	1.2
WV	Fayette	nd	nd	nd	300	300	3.7
WV	Kanawha	nd	nd	nd	110	110	1.4
WV	Logan	150	390	350	nd	890	11
WV	McDowell	nd	nd	nd	15	15	0.18
WV	Mingo	150	220	170	nd	540	6.6
WV	Raleigh	31	54	22	nd	110	1.3
WV	Webster	nd	nd	nd	46	46	0.56
WV	Wyoming	13	20	6.0	nd	39	0.47

APPENDIX 6

ESTIMATED COAL RESOURCES BY STATE, RELIABILITY CATEGORY, AND THICKNESS CATEGORY, FOR EACH COAL ZONE, REMAINING IN THE GROUND AS OF JANUARY 1, 1974 (IN MILLIONS OF SHORT TONS)

[Data are compiled from Appendix 3. Source: USCOAL coal resources database (U.S. Geological Survey, 1997; also available on the web at http://energy.er.usgs.gov/coalres.htm).]

Table A6–1. Estimated coal resources for the No. 5 Block coal zone by State, reliability category, and thickness category, remaining in the ground as of January 1, 1974 (in millions of short tons).

[Data are compiled from Appendix 3. na, not applicable; nd, no data available. Source: USCOAL coal resources database (U.S. Geological Survey, 1997; also available on the web at http://energy.er.usgs.gov/coalres.htm).]

State	Reliability category	Thickness category					Measured and indicated
		1.17 to 2.33 feet	>2.33 to 3.50 feet	>3.50 feet	Unclassified	Total	>2.33 feet
ALL	na	150	160	350	6,500	7,200	350
KY	na	140	140	170	nd	450	140
WV	na	5.7	22	180	6,500	6,700	200
KY	Measured	0.07	1.8	24	nd	26	na
KY	Indicated	37	41	77	nd	150	na
KY	Inferred	100	100	66	nd	270	na
WV	Measured	1.3	3.6	86	nd	90	na
WV	Indicated	4.4	18	96	nd	120	na
WV	Unclassified	nd	nd	nd	6,500	6,500	na

Table A6–2. Estimated coal resources for the Stockton and Coalburg coal zone by State, reliability category, and thickness category, remaining in the ground as of January 1, 1974 (in millions of short tons).

[Data are compiled from Appendix 3. na, not applicable; nd, no data available. Source: USCOAL coal resources database (U.S. Geological Survey, 1997; also available on the web at http://energy.er.usgs.gov/coalres.htm).]

State	Reliability category	Thickness category					Measured and indicated
		1.17 to 2.33 feet	>2.33 to 3.50 feet	>3.50 feet	Unclassified	Total	>2.33 feet
ALL	na	1,000	1,300	2,800	6,800	12,000	3,200
KY	na	860	1,000	2,100	nd	4,000	2,300
VA	na	0.91	16	12	nd	29	18
WV	na	150	220	700	6,800	7,900	920
KY	Measured	37	140	910	nd	1,100	na
KY	Indicated	340	520	730	nd	1,600	na
KY	Inferred	480	370	420	nd	1,300	na
VA	Measured	0.21	1.6	7.2	nd	9.0	na
VA	Indicated	0.63	3.7	5.2	nd	9.6	na
VA	Inferred	0.07	10	nd	nd	10	na
WV	Measured	23	35	290	nd	350	na
WV	Indicated	120	180	410	nd	720	na
WV	Unclassified	nd	nd	nd	6,800	6,800	na

APPENDIX 6—CONTINUED

Table A6–3. Estimated coal resources for the Winifrede/Hazard coal zone by State, reliability category, and thickness category, remaining in the ground as of January 1, 1974 (in millions of short tons).

[Data are compiled from Appendix 3. na, not applicable; nd, no data available. Source: USCOAL coal resources database (U.S. Geological Survey, 1997; also available on the web at http://energy.er.usgs.gov/coalres.htm).]

State	Reliability category	Thickness category					Measured and indicated
		1.17 to 2.33 feet	>2.33 to 3.50 feet	>3.50 feet	Unclassified	Total	>2.33 feet
ALL	na	1,100	1,400	750	2,600	5,900	1,800
KY	na	860	1,100	530	nd	2,500	1,300
TN	na	nd	65	13	nd	78	65
VA	na	2.7	6.6	22	nd	32	27
WV	na	260	190	190	2,600	3,300	380
KY	Measured	96	270	270	nd	640	na
KY	Indicated	420	570	190	nd	1,200	na
KY	Inferred	350	310	70	nd	730	na
TN	Measured	nd	33	9.9	nd	43	na
TN	Indicated	nd	20	2.8	nd	22	na
TN	Inferred	nd	12	0.44	nd	13	na
VA	Measured	nd	2.9	12	nd	15	na
VA	Indicated	0.98	2.3	9.9	nd	13	na
VA	Inferred	1.7	1.4	nd	nd	3.1	na
WV	Measured	40	70	160	nd	270	na
WV	Indicated	220	120	35	nd	380	na
WV	Unclassified	nd	nd	nd	2,600	2,600	na

Table A6–4. Estimated coal resources for the Williamson/Amburgy coal zone by State, reliability category, and thickness category, remaining in the ground as of January 1, 1974 (in millions of short tons).

[Data are compiled from Appendix 3. na, not applicable; nd, no data available. Source: USCOAL coal resources database (U.S. Geological Survey, 1997; also available on the web at http://energy.er.usgs.gov/coalres.htm).]

State	Reliability category	Thickness category					Measured and indicated
		1.17 to 2.33 feet	>2.33 to 3.50 feet	>3.50 feet	Unclassified	Total	>2.33 feet
ALL	na	1,300	1,200	480	1,600	4,600	1,200
KY	na	930	890	370	nd	2,200	740
TN	na	nd	54	0.29	nd	54	28
VA	na	55	45	21	nd	120	61
WV	na	270	240	88	1,600	2,200	330
KY	Measured	54	140	180	nd	380	na
KY	Indicated	310	290	130	nd	730	na
KY	Inferred	570	460	60	nd	1,100	na
TN	Measured	nd	6.1	0.25	nd	6.4	na
TN	Indicated	nd	22	0.04	nd	22	na
TN	Inferred	nd	26	nd	nd	26	na
VA	Measured	0.29	14	9.2	nd	24	na
VA	Indicated	1.1	25	12	nd	38	na
VA	Inferred	54	5.4	nd	nd	59	na
WV	Measured	110	130	85	nd	330	na
WV	Indicated	160	110	3.0	nd	270	na
WV	Unclassified	nd	nd	nd	1,600	1,600	na

APPENDIX 6—CONTINUED

Table A6–5. Estimated coal resources for the Campbell Creek/Upper Elkhorn No. 3 coal zone by State, reliability category, and thickness category, remaining in the ground as of January 1, 1974 (in millions of short tons).

[Data are compiled from Appendix 3. na, not applicable; nd, no data available. Source: USCOAL coal resources database (U.S. Geological Survey, 1997; also available on the web at http://energy.er.usgs.gov/coalres.htm).]

State	Reliability category	Thickness category					Measured and indicated
		1.17 to 2.33 feet	>2.33 to 3.50 feet	>3.50 feet	Unclassified	Total	>2.33 feet
ALL	na	1,700	3,100	2,500	5,900	13,000	5,000
KY	na	1,300	2,200	970	nd	4,500	2,600
VA	na	53	160	96	nd	310	240
WV	na	350	690	1,500	5,900	8,400	2,200
KY	Measured	140	670	680	nd	1,500	na
KY	Indicated	530	1,000	210	nd	1,800	na
KY	Inferred	680	540	82	nd	1,300	na
VA	Measured	0.98	25	31	nd	57	na
VA	Indicated	25	120	64	nd	210	na
VA	Inferred	27	13	0.81	nd	41	na
WV	Measured	240	550	1,400	nd	2,200	na
WV	Indicated	110	150	51	nd	300	na
WV	Unclassified	nd	nd	nd	5,900	5,900	na

Table A6–6. Estimated coal resources for the Upper Elkhorn Nos. 1 and 2/Powellton coal zone by State, reliability category, and thickness category, remaining in the ground as of January 1, 1974 (in millions of short tons).

[Data are compiled from Appendix 3. na, not applicable; nd, no data available. Source: USCOAL coal resources database (U.S. Geological Survey, 1997; also available on the web at http://energy.er.usgs.gov/coalres.htm).]

State	Reliability category	Thickness category					Measured and indicated
		1.17 to 2.33 feet	>2.33 to 3.50 feet	>3.50 feet	Unclassified	Total	>2.33 feet
ALL	na	2,400	3,500	1,700	580	8,200	4,300
KY	na	2,000	2,600	1,100	nd	5,700	2,900
TN	na	nd	130	12	nd	140	77
VA	na	59	100	37	nd	200	120
WV	na	340	680	550	580	2,100	1,200
KY	Measured	210	760	740	nd	1,700	na
KY	Indicated	800	1,100	330	nd	2,300	na
KY	Inferred	980	730	72	nd	1,800	na
TN	Measured	nd	33	4.7	nd	38	na
TN	Indicated	nd	37	1.8	nd	39	na
TN	Inferred	nd	62	5.5	nd	68	na
VA	Measured	nd	4.4	1.4	nd	5.8	na
VA	Indicated	2.2	83	36	nd	120	na
VA	Inferred	57	13	nd	nd	70	na
WV	Measured	200	500	420	nd	1,100	na
WV	Indicated	140	190	130	nd	450	na
WV	Unclassified	nd	nd	nd	580	580	na

APPENDIX 7

COAL-PRODUCTION DATABASE FOR ANNUAL COAL PRODUCTION BY STATE AND COAL-BED NAME FOR COAL BEDS THAT ARE INTERPRETED TO BE IN THE NO. 5 BLOCK, STOCKTON AND COALBURG, WINIFREDE/HAZARD, WILLIAMSON/AMBURGY, CAMPBELL CREEK/UPPER ELKHORN NO. 3, AND UPPER ELKHORN NOS. 1 AND 2/POWELLTON COAL ZONES

[Data are from various sources, cover different periods of record, and are in different degrees of detail. Asterisk (*) indicates interpretation for this report. Sources: See Appendix 8.]

CLICK HERE TO GO TO APPENDIX 7

The following is an explanation of the headings in electronic file CHAP_I_APPENDIX7.csv:

Headings in CHAP_I_APPENDIX7.csv	Explanation
Year	Year of reported coal production.
State	State of reported coal production.
County	County of reported coal production.
Geographic Region	Geographic region of coal production used in this report.*
Coal-Bed Name	Coal bed name reported with production data.
Coal Bed (This Report)	Revised coal bed correlation (this report) based on revisions to coal mining industry terminology in West Virginia (Appendix 2) and State and geographic region (Appendix 1).*
Coal-Zone Name	Correlative coal zone interpreted for this report.*
Code (This Report)	Numerical code for data entry and compilation purposes for this report.*
Mine Type	Surface or underground mining, where known.
Short Tons	Coal production reported in short tons.
Data Order	Indicates line number in database for this report.*

APPENDIX 8

SOURCES FOR THE COAL PRODUCTION DATA IN APPENDIX 7

EASTERN KENTUCKY

In 1998, John K. Hiett and Dan O'Canna (Kentucky Department of Mines and Minerals) provided unpublished annual coal production data for eastern Kentucky by Kentucky State coal-bed code and mine type from 1976 through 1992 and by coal-bed name and mine type from 1993 through 1996. Kentucky coal-bed codes were assigned to the production data from 1993 through 1996 by Sandra G. Neuzil for data entry and compilation for this report, based on unpublished listings of Kentucky coal-bed names and coal-bed codes provided by John K. Hiett and Dan O'Canna.

WEST VIRGINIA

In 1997, Gayle H. McColloch, Jr., (West Virginia Geological and Economic Survey) provided coal production data from the West Virginia Division of Miners Health, Safety, and Training-Safety Information System (WV MHST-SIS) database (managed by D. Kessler) by coal-bed name, mine type, and county from 1982 through 1996. Production in West Virginia was received with the mining industry's coal-bed name designations. In consultation with Bascombe M. Blake Jr., (West Virginia Geologic and Economic Survey), the coal production data was redesignated, on a county-by-county basis, to coal beds and then to coal zones that are interpreted to best represent the actual stratigraphic correlations (see Appendix 2, tables A2–1 through A2–7).

VIRGINIA

In 1997, Elizabeth V.M. Campbell (Virginia Division of Mineral Resources) compiled annual coal production data by coal-bed name for the 18 top-producing coal beds in Virginia, which each produced more than one million tons in 1995. The production values were compiled from published data in the annual reports of the Virginia Department of Labor and Industry, for the respective years 1972 through 1984; and from the annual reports of the Virginia Department of Mines, Minerals, and Energy, Division of Mines, for the respective years 1985 through 1995.

TENNESSEE

No coal production data were obtained by coal bed. Total coal production from all coal beds in Tennessee was 3.7 mst in 1996 (Energy Information Administration, 1997, see table 1). Tennessee probably contributes, at most, a small part of the central Appalachian Basin coal region production for the six coal zones in this report.

APPENDIX 9

ANNUAL COAL PRODUCTION IN KENTUCKY, VIRGINIA, AND WEST VIRGINIA BY MINE TYPE, ASSEMBLED FROM STATE AGENCIES, FOR EACH COAL ZONE (IN SHORT TONS)

[Data are compiled from Appendix 7. Data from Tennessee are not included because production data were not available by coal bed. Source: See Appendix 8.]

Table A9–1. Annual production from the No. 5 Block coal zone (including equivalent coal beds or coal zones) in Kentucky and West Virginia by mine type, assembled from State agencies (in short tons).

[Data are compiled from Appendix 7. nd, no data available or the absence of production. Sources: Gayle H. McColloch, Jr. (West Virginia Geological and Economic Survey, written commun., 1997) and John K. Hiett and Dan O'Canna (Kentucky Department of Mines and Minerals, written commun., 1998).]

Year	KY Richardson, Skyline coal zones Surface	KY Richardson, Skyline coal zones Underground	KY Richardson, Skyline coal zones Total	WV No. 5 Block coal zone Surface	WV No. 5 Block coal zone Underground	WV No. 5 Block coal zone Total	ALL No. 5 Block coal zone Total
1976	4,389,587	47,629	4,437,216	nd	nd	nd	nd
1977	5,124,884	159,891	5,284,775	nd	nd	nd	nd
1978	6,217,317	37,392	6,254,709	nd	nd	nd	nd
1979	nd	nd	nd	nd	nd	nd	nd
1980	nd	nd	nd	nd	nd	nd	nd
1981	9,185,043	16,509	9,201,552	nd	nd	nd	nd
1982	nd	nd	nd	6,501,831	3,911,834	10,413,665	nd
1983	6,293,744	23,354	6,317,098	6,655,538	2,036,456	8,691,994	15,009,092
1984	7,275,371	7,155	7,282,526	6,696,676	2,188,842	8,885,518	16,168,044
1985	4,598,831	128,296	4,727,127	6,289,636	2,455,243	8,744,879	13,472,006
1986	3,733,539	177,152	3,910,691	6,172,051	2,139,736	8,311,787	12,222,478
1987	2,340,805	78,282	2,419,087	7,436,535	1,646,591	9,083,126	11,502,213
1988	nd	nd	nd	9,101,249	1,885,272	10,986,521	10,986,521
1989	5,345,160	16,797	5,361,957	11,588,468	1,879,334	13,467,802	18,829,759
1990	4,401,499	288,597	4,690,096	14,032,261	2,438,021	16,470,282	21,160,378
1991	nd	nd	nd	13,172,519	2,575,574	15,748,093	15,748,093
1992	nd	nd	nd	15,528,217	1,960,821	17,489,038	17,489,038
1993	1,128,575	nd	1,128,575	14,899,978	856,726	15,756,704	16,885,279
1994	1,109,733	nd	1,109,733	20,414,724	279,949	20,694,673	21,804,406
1995	1,911,291	nd	1,911,291	20,528,740	132,570	20,661,310	22,572,601
1996	1,399,349	nd	1,399,349	21,558,825	236,346	21,795,171	23,194,520

APPENDIX 9—CONTINUED

Table A9–2. Annual production from the Stockton and Coalburg coal zone (including equivalent coal beds or coal zones) in Kentucky, Virginia, and West Virginia by mine type (where available), assembled from State agencies (in short tons).

[Data are compiled from Appendix 7. nd, no data available or the absence of production. Sources: Elizabeth V.M. Campbell (Virginia Division of Mineral Resources, written commun., 1997), Gayle H. McColloch, Jr. (West Virginia Geological and Economic Survey, written commun., 1997), and John K. Hiett and Dan O'Canna (Kentucky Department of Mines and Minerals, written commun., 1998).]

Year	KY Broas coal zone Surface	KY Broas coal zone Underground	KY Peach Orchard coal zone Surface	KY Peach Orchard coal zone Underground	KY Broas and Peach Orchard coal zones Total	VA High Splint coal bed Total	WV Stockton coal zone Surface	WV Stockton coal zone Underground	WV Coalburg coal zone Surface	WV Coalburg coal zone Underground	WV Stockton and Coalburg coal zones Total	ALL Stockton and Coalburg coal zone Total
1972	nd	nd	nd	nd	nd	320,000	nd	nd	nd	nd	nd	nd
1973	nd	nd	nd	nd	nd	300,000	nd	nd	nd	nd	nd	nd
1974	nd	nd	nd	nd	nd	200,000	nd	nd	nd	nd	nd	nd
1975	nd	nd	nd	nd	nd	200,000	nd	nd	nd	nd	nd	nd
1976	8,546,102	1,150,277	8,525,253	2,898,259	21,119,891	160,000	nd	nd	nd	nd	nd	nd
1977	9,951,132	1,284,000	11,518,562	3,101,813	25,855,507	150,000	nd	nd	nd	nd	nd	nd
1978	7,217,760	1,640,123	10,792,170	2,583,713	22,233,766	230,000	nd	nd	nd	nd	nd	nd
1979	6,580,365	2,467,265	9,375,836	3,413,016	21,836,482	350,000	nd	nd	nd	nd	nd	nd
1980	6,960,316	2,403,819	11,045,429	3,440,724	23,850,288	200,000	nd	nd	nd	nd	nd	nd
1981	6,158,053	2,181,865	15,220,965	3,821,269	27,382,152	160,000	nd	nd	nd	nd	nd	nd
1982	6,517,343	2,198,380	15,524,504	3,937,215	28,177,442	360,000	1,361,456	2,487,252	1,515,886	7,585,027	12,949,621	41,487,063
1983	5,622,989	1,414,021	14,273,434	3,334,687	24,645,131	730,000	1,050,271	2,289,369	1,399,728	6,870,171	11,609,539	36,984,670
1984	5,583,134	1,663,014	17,485,861	5,746,866	30,478,875	610,000	1,399,292	2,847,875	1,966,019	7,914,501	14,127,687	45,216,562
1985	8,526,158	3,003,893	16,483,278	6,142,141	34,155,470	520,000	1,513,011	3,213,898	2,908,302	7,233,334	14,868,545	49,544,015
1986	8,422,116	2,310,999	14,451,762	5,457,474	30,642,351	450,000	1,079,306	4,779,133	6,402,977	7,720,413	19,981,829	51,074,180
1987	7,872,748	3,170,607	16,813,343	4,066,190	31,922,888	290,000	132,951	5,476,266	7,303,095	8,258,193	21,170,505	53,383,393
1988	5,330,522	3,743,137	15,310,574	3,889,143	28,273,376	220,000	1,074,371	5,465,581	8,054,208	8,313,776	22,907,936	51,401,312
1989	5,964,688	3,868,153	17,110,671	4,002,184	30,945,696	280,000	873,916	4,842,025	8,848,968	8,384,321	22,949,230	54,174,926
1990	5,415,394	3,073,493	18,051,494	3,770,033	30,310,414	190,000	3,764,536	5,880,674	8,443,266	9,590,281	27,678,757	58,179,171
1991	5,542,454	2,703,764	16,243,630	2,881,997	27,371,845	400,000	4,593,492	4,718,503	9,339,575	9,333,885	27,985,455	55,757,300
1992	6,955,675	2,112,222	17,138,188	3,631,061	29,837,146	480,000	5,744,644	4,256,200	5,267,311	10,693,421	25,961,576	56,278,722
1993	4,387,198	1,368,837	16,852,540	6,630,366	29,238,941	620,000	2,680,364	3,113,989	5,128,015	9,650,578	20,572,946	50,431,887
1994	4,091,007	1,456,656	17,424,520	5,849,955	28,822,138	440,000	3,065,078	4,328,735	7,589,422	11,711,719	26,694,954	55,957,092
1995	5,030,415	1,240,557	13,184,461	4,449,204	23,904,637	210,000	4,045,141	4,668,645	7,822,937	12,732,058	29,268,781	53,383,418
1996	2,894,385	1,157,899	12,425,773	4,832,859	21,310,916	nd	4,942,852	5,174,195	7,019,954	14,968,461	32,105,462	53,416,378

APPENDIX 9—CONTINUED

Table A9–3. Annual production from the Winifrede/Hazard coal zone (including equivalent coal beds or coal zones) in Kentucky and West Virginia by mine type, assembled from State agencies (in short tons).

[Data are compiled from Appendix 7. nd, no data available or the absence of production. Sources: Gayle H. McColloch, Jr. (West Virginia Geological and Economic Survey, written commun., 1997) and John K. Hiett and Dan O'Canna (Kentucky Department of Mines and Minerals, written commun., 1998).]

Year	KY Hazard coal zone Surface	KY Hazard coal zone Underground	KY Haddix coal zone Surface	KY Haddix coal zone Underground	KY Hazard and Haddix coal zones Total	WV Winifrede coal zone Surface	WV Winifrede coal zone Underground	WV Winifrede coal zone Total	ALL Winifrede/ Hazard coal zone Total
1976	5,086,828	2,843,160	218,053	3,052	8,151,093	nd	nd	nd	nd
1977	4,836,064	2,950,538	154,796	2,638	7,944,036	nd	nd	nd	nd
1978	5,416,111	2,529,281	330,630	18,017	8,294,039	nd	nd	nd	nd
1979	5,205,448	2,940,342	310,608	30,104	8,486,502	nd	nd	nd	nd
1980	6,147,371	3,778,160	94,330	13,098	10,032,959	nd	nd	nd	nd
1981	6,039,593	3,194,977	339,063	66,002	9,639,635	nd	nd	nd	nd
1982	5,852,717	3,527,286	268,679	79,202	9,727,884	142,277	6,176,160	6,318,437	16,046,321
1983	4,733,596	2,679,124	nd	nd	7,412,720	451,669	4,814,262	5,265,931	12,678,651
1984	6,783,150	3,365,295	302,471	170,385	10,621,301	519,654	6,029,953	6,549,607	17,170,908
1985	6,111,670	2,988,703	241,046	64,171	9,405,590	137,461	7,150,845	7,288,306	16,693,896
1986	6,107,677	2,406,081	172,733	260,589	8,947,080	223,695	7,797,943	8,021,638	16,968,718
1987	6,307,230	2,312,806	184,817	265,963	9,070,816	377,689	8,310,516	8,688,205	17,759,021
1988	6,091,423	3,048,965	665,261	61,818	9,867,467	660,890	7,090,387	7,751,277	17,618,744
1989	5,476,478	3,781,625	693,659	376,651	10,328,413	604,156	6,644,629	7,248,785	17,577,198
1990	5,763,940	3,297,411	1,778,697	36,931	10,876,979	1,355,816	7,427,798	8,783,614	19,660,593
1991	3,505,484	1,882,517	1,822,110	173,990	7,384,101	2,981,809	7,653,708	10,635,517	18,019,618
1992	4,731,973	1,990,720	865,567	293,098	7,881,358	4,146,103	7,715,641	11,861,744	19,743,102
1993	2,095,874	3,496,102	1,214,622	8,806	6,815,404	3,331,789	4,665,838	7,997,627	14,813,031
1994	922,178	3,380,287	176,278	475,700	4,954,443	5,930,985	4,109,507	10,040,492	14,994,935
1995	1,764,725	854,086	202,007	955,900	3,776,718	6,860,805	4,552,985	11,413,790	15,190,508
1996	2,524,697	597,611	209,524	1,165,758	4,497,590	7,327,353	5,115,909	12,443,262	16,940,852

APPENDIX 9—CONTINUED

Table A9–4. Annual production from the Williamson/Ambrugy coal zone (including equivalent coal beds or coal zones) in Kentucky, Virginia, and West Virginia by mine type (where available), assembled from State agencies (in short tons).

[Data are compiled from Appendix 7. nd, no data available or the absence of production. Sources: Elizabeth V.M. Campbell (Virginia Division of Mineral Resources, written commun., 1997), Gayle H. McColloch, Jr. (West Virginia Geological and Economic Survey, written commun., 1997), and John K. Hiett and Dan O'Canna (Kentucky Department of Mines and Minerals, written commun., 1998).]

Year	KY Williamson, Ambrugy coal zones Surface	KY Williamson, Ambrugy coal zones Underground	KY Williamson, Ambrugy coal zones Total	VA Low Splint coal bed Total	WV Williamson coal zone Surface	WV Williamson coal zone Underground	WV Williamson coal zone Total	ALL Williamson/ Ambrugy coal zone Total
1972	nd	nd	nd	260,000	nd	nd	nd	nd
1973	nd	nd	nd	230,000	nd	nd	nd	nd
1974	nd	nd	nd	160,000	nd	nd	nd	nd
1975	nd	nd	nd	200,000	nd	nd	nd	nd
1976	580,181	1,970,058	2,550,239	390,000	nd	nd	nd	nd
1977	522,948	2,138,115	2,661,063	650,000	nd	nd	nd	nd
1978	427,716	1,923,153	2,350,869	510,000	nd	nd	nd	nd
1979	439,745	2,297,254	2,736,999	530,000	nd	nd	nd	nd
1980	721,070	2,241,812	2,962,882	500,000	nd	nd	nd	nd
1981	195,058	2,488,107	2,683,165	390,000	nd	nd	nd	nd
1982	415,361	2,773,168	3,188,529	590,000	68,714	1,769,749	1,838,463	5,616,992
1983	293,115	2,228,873	2,521,988	380,000	57,002	1,496,952	1,553,954	4,455,942
1984	171,540	2,677,551	2,849,091	670,000	78,507	1,968,093	2,046,600	5,565,691
1985	350,340	2,766,719	3,117,059	600,000	35,802	1,566,128	1,601,930	5,318,989
1986	822,138	3,207,220	4,029,358	510,000	84,865	1,783,058	1,867,923	6,407,281
1987	1,793,505	3,170,412	4,963,917	680,000	42,633	1,352,782	1,395,415	7,039,332
1988	1,320,136	2,893,172	4,213,308	640,000	nd	2,199,053	2,199,053	7,052,361
1989	1,748,219	2,952,135	4,700,354	550,000	3,394	2,359,915	2,363,309	7,613,663
1990	1,148,000	4,564,428	5,712,428	750,000	1,336	2,559,630	2,560,966	9,023,394
1991	500,639	5,369,847	5,870,486	580,000	nd	2,651,193	2,651,193	9,101,679
1992	809,268	4,184,562	4,993,830	600,000	349,682	2,586,238	2,935,920	8,529,750
1993	2,238,677	3,343,485	5,582,162	670,000	132,548	1,698,138	1,830,686	8,082,848
1994	2,539,436	4,269,061	6,808,497	640,000	648,363	1,026,881	1,675,244	9,123,741
1995	2,197,810	3,727,773	5,925,583	720,000	924,562	886,713	1,811,275	8,456,858
1996	2,361,550	4,452,485	6,814,035	nd	808,941	1,221,723	2,030,664	8,844,699

APPENDIX 9—CONTINUED

Table A9–5. Annual production from the Campbell Creek/Upper Elkhorn No. 3 coal zone (including equivalent coal beds or coal zones) in Kentucky, Virginia, and West Virginia by mine type (where available), assembled from State agencies (in short tons).

[Data are compiled from Appendix 7. nd, no data available or the absence of production. Sources: Elizabeth V.M. Campbell (Virginia Division of Mineral Resources, written commun., 1997), Gayle H. McColloch, Jr. (West Virginia Geological and Economic Survey, written commun., 1997), and John K. Hiett and Dan O'Canna (Kentucky Department of Mines and Minerals, written commun., 1998).]

Year	KY Upper Elkhorn No. 3 coal zone Surface	KY Upper Elkhorn No. 3 coal zone Underground	KY Upper Elkhorn No. 3 coal zone Total	VA Taggart coal zone Total	WV Campbell Creek coal zone Surface	WV Campbell Creek coal zone Underground	WV Campbell Creek coal zone Total	ALL Campbell Creek/Upper Elkhorn No. 3 coal zone Total
1972	nd	nd	nd	2,550,000	nd	nd	nd	nd
1973	nd	nd	nd	3,550,000	nd	nd	nd	nd
1974	nd	nd	nd	2,600,000	nd	nd	nd	nd
1975	nd	nd	nd	2,490,000	nd	nd	nd	nd
1976	2,694,613	5,658,036	8,352,649	2,280,000	nd	nd	nd	nd
1977	2,822,378	7,771,452	10,593,830	1,980,000	nd	nd	nd	nd
1978	1,870,569	6,090,476	7,961,045	2,010,000	nd	nd	nd	nd
1979	1,346,336	7,286,287	8,632,623	2,160,000	nd	nd	nd	nd
1980	1,041,432	6,594,834	7,636,266	2,120,000	nd	nd	nd	nd
1981	1,027,119	9,018,100	10,045,219	1,980,000	nd	nd	nd	nd
1982	1,233,181	7,087,539	8,320,720	2,300,000	287,216	8,921,335	9,208,551	19,829,271
1983	1,368,132	9,584,508	10,952,640	2,320,000	310,989	7,731,799	8,042,788	21,315,428
1984	2,058,936	9,015,937	11,074,873	2,280,000	544,577	8,382,082	8,926,659	22,281,532
1985	1,673,596	9,236,526	10,910,122	1,830,000	700,305	9,187,124	9,887,429	22,627,551
1986	2,025,090	8,756,736	10,781,826	2,190,000	935,540	10,059,588	10,995,128	23,966,954
1987	2,232,295	8,247,145	10,479,440	2,390,000	1,729,209	9,941,038	11,670,247	24,539,687
1988	2,334,535	7,492,222	9,826,757	2,100,000	2,550,595	10,690,440	13,241,035	25,167,792
1989	1,471,960	9,996,524	11,468,484	2,250,000	3,343,340	11,553,437	14,896,777	28,615,261
1990	1,821,995	9,926,277	11,748,272	2,160,000	4,128,946	13,388,053	17,516,999	31,425,271
1991	1,413,316	7,974,104	9,387,420	1,160,000	3,547,953	14,438,834	17,986,787	28,534,207
1992	2,060,228	8,936,448	10,996,676	1,840,000	1,162,951	14,894,974	16,057,925	28,894,601
1993	1,769,773	11,491,617	13,261,390	1,280,000	615,027	13,358,571	13,973,598	28,514,988
1994	2,454,146	11,028,756	13,482,902	950,000	1,967,102	15,795,451	17,762,553	32,195,455
1995	2,199,511	12,514,755	14,714,266	880,000	1,450,043	15,791,659	17,241,702	32,835,968
1996	4,599,743	12,229,303	16,829,046	nd	1,564,553	13,838,712	15,403,265	32,232,311

APPENDIX 9—CONTINUED

Table A9–6. Annual production from the Upper Elkhorn Nos. 1 and 2/Powellton coal zone (including equivalent coal beds or coal zones) in Kentucky, Virginia, and West Virginia by mine type (where available), assembled from State agencies (in short tons).

[Data are compiled from Appendix 7. nd, no data available or the absence of production. Sources: Elizabeth V.M. Campbell (Virginia Division of Mineral Resources, written commun., 1997), Gayle H. McColloch, Jr. (West Virginia Geological and Economic Survey, written commun., 1997), and John K. Hiett and Dan O'Canna (Kentucky Department of Mines and Minerals, written commun., 1998).]

Year	KY Upper Elkhorn No. 1, Upper Elkhorn No. 2 coal beds Surface	KY Upper Elkhorn No. 1, Upper Elkhorn No. 2 coal beds Underground	KY Upper Elkhorn Nos. 1 and 2 coal zone Total	VA Wilson, Upper St. Charles coal beds Total	WV Powellton coal zone Surface	WV Powellton coal zone Underground	WV Powellton coal zone Total	ALL Upper Elkhorn Nos. 1 and 2/ Powellton coal zone Total
1972	nd	nd	nd	150,000	nd	nd	nd	nd
1973	nd	nd	nd	350,000	nd	nd	nd	nd
1974	nd	nd	nd	200,000	nd	nd	nd	nd
1975	nd	nd	nd	320,000	nd	nd	nd	nd
1976	2,527,404	7,889,631	10,417,035	320,000	nd	nd	nd	nd
1977	2,410,948	6,305,204	8,716,152	310,000	nd	nd	nd	nd
1978	2,648,325	7,479,900	10,128,225	250,000	nd	nd	nd	nd
1979	2,130,904	10,594,101	12,725,005	300,000	nd	nd	nd	nd
1980	2,489,633	10,527,744	13,017,377	260,000	nd	nd	nd	nd
1981	2,438,368	7,935,134	10,373,502	250,000	nd	nd	nd	nd
1982	2,277,087	8,846,705	11,123,792	300,000	40,436	1,998,699	2,039,135	13,462,927
1983	2,336,695	7,116,347	9,453,042	480,000	77,981	2,154,073	2,232,054	12,165,096
1984	2,301,996	12,372,384	14,674,380	640,000	208,098	2,973,071	3,181,169	18,495,549
1985	2,501,428	11,303,758	13,805,186	660,000	93,012	3,630,111	3,723,123	18,188,309
1986	2,247,692	11,712,430	13,960,122	840,000	131,395	4,338,714	4,470,109	19,270,231
1987	2,763,287	12,552,957	15,316,244	1,010,000	287,523	4,578,880	4,866,403	21,192,647
1988	2,192,077	12,909,203	15,101,280	1,050,000	658,785	4,065,230	4,724,015	20,875,295
1989	1,745,976	14,866,954	16,612,930	930,000	666,683	5,897,365	6,564,048	24,106,978
1990	2,527,793	15,934,856	18,462,649	900,000	832,390	6,799,750	7,632,140	26,994,789
1991	2,890,276	15,647,095	18,537,371	1,050,000	1,785,952	5,303,875	7,089,827	26,677,198
1992	2,620,880	14,338,191	16,959,071	1,700,000	2,987,982	5,123,715	8,111,697	26,770,768
1993	8,479,461	11,638,721	20,118,182	1,140,000	2,405,557	5,931,237	8,336,794	29,594,976
1994	6,865,206	16,415,641	23,280,847	570,000	414,903	6,791,776	7,206,679	31,057,526
1995	8,721,097	12,557,262	21,278,359	1,230,000	24,761	7,707,894	7,732,655	30,241,014
1996	10,304,153	10,681,237	20,985,390	nd	nd	8,039,840	8,039,840	29,025,230

APPENDIX 10

COAL-QUALITY DATABASE FOR THE NO. 5 BLOCK, STOCKTON AND COALBURG, WINIFREDE/HAZARD, WILLIAMSON/AMBURGY, CAMPBELL CREEK/UPPER ELKHORN NO. 3, AND UPPER ELKHORN NOS. 1 AND 2/POWELLTON COAL ZONES

[Data are from the COALQUAL database (Bragg and others, 1998) and were used to compile the information presented in Appendixes 11 through 16. Abbreviations are as follows: a, see Bragg and others (1998) for further explanation; b, columns of information added for this report; c, more than 10 percent of analyses are qualified data, use data with extreme caution. Note: Data for proximate and ultimate analyses, major-element concentrations, and trace-element concentrations are from the COALQUAL database and are included for each coal sample in electronic file CHAP_I_APPENDIX10.csv (this CD–ROM) although these additional parameters are not discussed in this report. Source: Bragg and others (1998).]

CLICK HERE TO GO TO APPENDIX 10

The following is a brief explanation for each column in electronic file CHAP_I_APPENDIX10.csv (see techinfo.pdf in Bragg and others (1998) for more detailed explanations):

Column Heading	Comments	Units	Reported Basis	Explanation See techinfo.pdf in Bragg and others (1998)
SAMPLENO	a,b			Lab ID and sample number.
STATE	a			State name where sample was collected.
COUNTY	a			County name in State where sample was collected.
LATITUDE	a	decimal degrees		Latitude coordinates.
LONGITUDE	a	decimal degrees		Longitude coordinates.
CPROVINC	a			Coal province name.
CREGION	a			Coal region name.
CFIELD	a			Coal field name.
DISTRICT	a			District name, mining district, or other subdivision.
CFORMATN	a			Stratigraphic formation name.
CGROUP	a			Stratigraphic group name.
CBED	a			Coal bed name specified by the collector of the sample.
CZONE_NAME	b			Coal zone name, this report.
CODE (This report)	b			Coal zone code for data entry purposes, this report.
DEPTH	a	inches		Depth from surface of the earth.
DEPTH_FT	b	feet		Depth from surface of the earth.
SAMPTHK	a	inches		Thickness of the sample.
SAMPTHK_FT	b	feet		Thickness of the sample.
SYSTEM	a			Geologic system.
SER_EPOC	a			Geologic series or epoch.
COMMENTS	a			Comment field.
MAP	a			Topographic or other map name.

APPENDIX 10—CONTINUED

Column Heading	Comments	Units	Reported Basis	Explanation See techinfo.pdf in Bragg and others (1998)
COLLECTR	a			Name of agency and person collecting or submitting sample.
POINTID	a			Field number assigned by the collector.
SUBDATE	a			Date sample confirmed by USGS (MM/DD/YY).
ESTRANK	a,c			Estimated rank.
LABCODE	a			Name of lab(s) that performed analyses.
SAMPTYPE	a			Description of sample type.
ANALTYPE	a			Analysis performed on sample as it is received in the lab (as-received/as-determined).
VALREP	a			Single samples, splits (incremental samples, not bench) or composite samples are represented.
BTU	a	Btu/lb	as-received, whole coal	Gross calorific value by ASTM method D-2015.
ASHDEF	a,c	degrees Fahrenheit	as-received, whole coal	Ash deformation temperature by ASTM method D1857- in reducing atmosphere.
ASHSOF	a,c	degrees Fahrenheit	as-received, whole coal	Ash softening temperature by ASTM method D1857- in reducing atmosphere.
ASHFLD	a,c	degrees Fahrenheit	as-received, whole coal	Ash fluid temperature by ASTM method D1857- in reducing atmosphere.
FRESWL	a		as-received, whole coal	Free swelling index by ASTM method D-720.
MOISTR	a	percent	as-received, whole coal	Moisture content by ASTM method D-3173.
VOLMAT	a	percent	as-received, whole coal	Volatile matter content by ASTM method D-3175.
FIXEDC	a	percent	as-received, whole coal	Fixed carbon content by ASTM method D-3172.
STDASH	a	percent	as-received, whole coal	Ash yield by ASTM method D-3174 at 750 degrees C .
HYDRGN	a	percent	as-received, whole coal	Hydrogen content by ASTM method D-3178; hydrogen as reported includes hydrogen in water.
CARBON	a	percent	as-received, whole coal	Carbon content by ASTM method D-3178.
NITRGN	a	percent	as-received, whole coal	Nitrogen content by ASTM method D-3179.
OXYGEN	a	percent	as-received, whole coal	Oxygen content by ASTM method D-3176; oxygen as reported includes oxygen in water.
SULFUR	a	percent	as-received, whole coal	Sulfur content by ASTM method D-3177.
SLFATE	a,c	percent	as-received, whole coal	Sulfate sulfur content by ASTM method D-2492.
SLFPYR	a,c	percent	as-received, whole coal	Pyritic sulfur content by ASTM method D-2492.
SLFORG	a,c	percent	as-received, whole coal	Organic sulfur content by ASTM method D-2492.
ADLOSS	a	percent	as-received, whole coal	Air dried loss by ASTM method D-2013.
HGI	a		as-received, whole coal	Hardgrove grindability index by ASTM method D-409.
EQMOIS	a	percent	as-received, whole coal	Equilibrium moisture content by ASTM method D-1412.
GSASH	a	percent	remnant moisture, ash	Ash yield determined by USGS method at 525 degrees C.
SI_E	a	ppm	remnant moisture, whole coal	Silicon
AL_E	a	ppm	remnant moisture, whole coal	Aluminum
CA_E	a	ppm	remnant moisture, whole coal	Calcium
MG_E	a	ppm	remnant moisture, whole coal	Magnesium
NA_E	a	ppm	remnant moisture, whole coal	Sodium
K_E	a	ppm	remnant moisture, whole coal	Potassium
FE_E	a	ppm	remnant moisture, whole coal	Iron
TI_E	a	ppm	remnant moisture, whole coal	Titanium
S_E	a	ppm	remnant moisture, whole coal	Sulfur
AG_E	a,c	ppm	remnant moisture, whole coal	Silver
AS_E	a	ppm	remnant moisture, whole coal	Arsenic
B_E	a	ppm	remnant moisture, whole coal	Boron
BA_E	a	ppm	remnant moisture, whole coal	Barium
BE_E	a	ppm	remnant moisture, whole coal	Beryllium
BR_E	a	ppm	remnant moisture, whole coal	Bromine
CD_E	a,c	ppm	remnant moisture, whole coal	Cadmium
CE_E	a,c	ppm	remnant moisture, whole coal	Cerium
CL_E	a,c	ppm	remnant moisture, whole coal	Chlorine
CO_E	a	ppm	remnant moisture, whole coal	Cobalt
CR_E	a	ppm	remnant moisture, whole coal	Chromium
CS_E	a	ppm	remnant moisture, whole coal	Cesium
CU_E	a	ppm	remnant moisture, whole coal	Copper
EU_E	a	ppm	remnant moisture, whole coal	Europium
F_E	a	ppm	remnant moisture, whole coal	Fluorine
GA_E	a	ppm	remnant moisture, whole coal	Gallium
GE_E	a,c	ppm	remnant moisture, whole coal	Germanium

APPENDIX 10—CONTINUED

Column Heading	Comments	Units	Reported Basis	Explanation See techinfo.pdf in Bragg and others (1998)
HF_E	a,c	ppm	remnant moisture, whole coal	Hafnium
HG_E	a	ppm	remnant moisture, whole coal	Mercury
LA_E	a,c	ppm	remnant moisture, whole coal	Lanthanum
LI_E	a	ppm	remnant moisture, whole coal	Lithium
LU_E	a	ppm	remnant moisture, whole coal	Lutetium
MN_E	a	ppm	remnant moisture, whole coal	Manganese
MO_E	a	ppm	remnant moisture, whole coal	Molybdenum
NB_E	a,c	ppm	remnant moisture, whole coal	Niobium
ND_E	a,c	ppm	remnant moisture, whole coal	Neodymium
NI_E	a	ppm	remnant moisture, whole coal	Nickel
P_E	a,c	ppm	remnant moisture, whole coal	Phosphorus
PB_E	a	ppm	remnant moisture, whole coal	Lead
SB_E	a	ppm	remnant moisture, whole coal	Antimony
SC_E	a	ppm	remnant moisture, whole coal	Scandium
SE_E	a	ppm	remnant moisture, whole coal	Selenium
SM_E	a	ppm	remnant moisture, whole coal	Samarium
SN_E	a,c	ppm	remnant moisture, whole coal	Tin
SR_E	a	ppm	remnant moisture, whole coal	Strontium
TA_E	a,c	ppm	remnant moisture, whole coal	Tantalum
TB_E	a,c	ppm	remnant moisture, whole coal	Terbium
TH_E	a	ppm	remnant moisture, whole coal	Thorium
U_E	a	ppm	remnant moisture, whole coal	Uranium
V_E	a	ppm	remnant moisture, whole coal	Vanadium
W_E	a,c	ppm	remnant moisture, whole coal	Tungsten
Y_E	a	ppm	remnant moisture, whole coal	Yttrium
YB_E	a	ppm	remnant moisture, whole coal	Ytterbium
ZN_E	a	ppm	remnant moisture, whole coal	Zinc
ZR_E	a	ppm	remnant moisture, whole coal	Zirconium
SO2	b	lbs SO_2/million Btu	as-received, whole coal	Calculated from sulfur content and Btu value.
Data_Order	b			Indicates line number in database for this report.

APPENDIX 11

ASH YIELD (WEIGHT PERCENT; AMERICAN SOCIETY FOR TESTING AND MATERIALS METHOD) MEANS, RANGES, AND STANDARD DEVIATIONS FOR SAMPLES ON AN AS-RECEIVED WHOLE-COAL BASIS, BY STATE AND COUNTY, FOR EACH COAL ZONE

Table A11–1. Ash yield (weight percent; American Society for Testing and Materials method) means, ranges, and standard deviations for samples of the No. 5 Block coal zone on an as-received whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	11.83	2.70	31.50	5.52	85
KY	na	11.60	4.70	29.10	5.03	45
WV	na	12.09	2.70	31.50	6.08	40
KY	Boyd	18.73	11.40	29.10	9.23	3
KY	Breathitt	8.69	6.16	15.28	2.59	11
KY	Carter	nd	9.80	9.80	nd	1
KY	Floyd	nd	13.56	13.56	nd	1
KY	Greenup	nd	14.50	14.50	nd	1
KY	Johnson	nd	13.36	13.36	nd	1
KY	Knott	nd	4.84	4.84	nd	1
KY	Lawrence	11.29	6.40	19.30	4.68	9
KY	Leslie	12.88	5.55	21.24	4.81	7
KY	Magoffin	10.80	9.30	12.30	2.12	2
KY	Martin	13.74	6.76	21.90	5.09	7
KY	Pike	nd	4.70	4.70	nd	1
WV	Boone	10.79	5.90	17.40	3.61	12
WV	Fayette	11.55	7.70	14.70	2.94	4
WV	Kanawha	13.64	2.70	31.50	8.37	17
WV	Logan	8.22	7.86	8.57	0.50	2
WV	Nicholas	nd	18.00	18.00	nd	1
WV	Raleigh	9.55	8.10	11.35	1.65	3
WV	Webster	nd	12.80	12.80	nd	1

APPENDIX 11—CONTINUED

Table A11–2. Ash yield (weight percent; American Society for Testing and Materials method) means, ranges, and standard deviations for samples of the Stockton and Coalburg coal zone on an as-received whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	11.39	2.70	30.70	5.60	203
KY	na	10.92	2.70	30.70	5.20	160
VA	na	nd	17.00	17.00	nd	1
WV	na	13.07	2.90	29.00	6.72	42
KY	Bell	8.40	3.42	15.43	5.32	6
KY	Breathitt	10.32	6.26	15.57	2.89	11
KY	Carter	5.55	3.80	7.30	2.47	2
KY	Elliott	9.24	4.92	16.00	4.69	5
KY	Floyd	11.12	4.60	15.20	3.82	6
KY	Greenup	13.27	4.30	25.70	8.60	6
KY	Harlan	10.54	6.66	14.37	3.17	6
KY	Johnson	16.79	6.26	30.70	12.06	5
KY	Knott	15.72	10.40	29.60	6.79	7
KY	Knox	nd	9.66	9.66	nd	1
KY	Lawrence	8.32	3.13	14.53	3.25	14
KY	Leslie	9.53	6.04	13.04	2.85	10
KY	Magoffin	10.34	3.36	17.81	4.41	13
KY	Martin	11.01	2.90	17.40	4.19	22
KY	Morgan	13.51	4.48	22.00	7.58	5
KY	Perry	12.49	2.70	23.90	4.96	28
KY	Pike	8.21	3.11	13.45	3.23	13
VA	Wise	nd	17.00	17.00	nd	1
WV	Boone	16.08	8.60	24.60	6.46	7
WV	Fayette	nd	13.70	13.70	nd	1
WV	Kanawha	12.48	4.00	29.00	6.61	17
WV	Lincoln	nd	2.90	2.90	nd	1
WV	Logan	13.50	3.30	28.20	7.54	13
WV	Mingo	8.85	6.70	11.00	3.04	2
WV	Nicholas	nd	14.50	14.50	nd	1

APPENDIX 11—CONTINUED

Table A11–3. Ash yield (weight percent; American Society for Testing and Materials method) means, ranges, and standard deviations for samples of the Winifrede/Hazard coal zone on an as-received whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	10.14	2.00	28.50	5.94	87
KY	na	10.26	2.00	26.40	5.75	62
TN	na	3.68	3.20	4.90	0.71	5
VA	na	5.32	4.15	6.80	1.35	3
WV	na	12.46	3.40	28.50	6.30	17
KY	Bell	11.75	7.67	19.80	5.54	4
KY	Breathitt	9.22	3.50	14.37	5.67	4
KY	Clay	11.68	4.85	20.18	5.60	8
KY	Harlan	5.28	2.44	8.21	2.89	3
KY	Johnson	nd	22.60	22.60	nd	1
KY	Knott	10.67	3.19	26.40	8.72	7
KY	Lawrence	3.60	2.00	5.30	1.65	3
KY	Leslie	10.32	3.12	16.23	4.87	11
KY	Letcher	12.93	9.50	15.10	2.47	4
KY	Magoffin	10.95	9.49	12.40	2.06	2
KY	Martin	nd	9.10	9.10	nd	1
KY	Morgan	11.05	3.00	24.00	11.33	3
KY	Owsley	nd	18.70	18.70	nd	1
KY	Perry	8.70	5.37	16.70	3.29	10
TN	Anderson	3.30	3.20	3.40	0.14	2
TN	Campbell	4.30	3.70	4.90	0.85	2
TN	Morgan	nd	3.20	3.20	nd	1
VA	Wise	5.32	4.15	6.80	1.35	3
WV	Boone	10.11	3.80	18.14	5.94	4
WV	Kanawha	11.58	7.79	17.80	3.48	7
WV	Logan	19.10	10.30	28.50	7.46	4
WV	Mingo	nd	3.40	3.40	nd	1
WV	Raleigh	nd	10.48	10.48	nd	1

APPENDIX 11—CONTINUED

Table A11–4. Ash yield (weight percent; American Society for Testing and Materials method) means, ranges, and standard deviations for samples of the Williamson/Amburgy coal zone on an as-received whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	8.76	2.30	26.10	4.99	44
KY	na	8.92	2.76	26.10	5.00	33
TN	na	7.14	2.30	14.04	5.08	6
VA	na	8.40	4.50	10.70	3.40	3
WV	na	11.50	5.00	18.00	9.19	2
KY	Bell	6.45	2.76	8.60	2.34	5
KY	Breathitt	nd	7.97	7.97	nd	1
KY	Carter	nd	11.35	11.35	nd	1
KY	Clay	nd	12.60	12.60	nd	1
KY	Floyd	nd	9.87	9.87	nd	1
KY	Harlan	10.56	6.94	14.18	5.12	2
KY	Johnson	6.88	5.94	7.90	0.80	4
KY	Knott	nd	24.40	24.40	nd	1
KY	Lawrence	nd	6.70	6.70	nd	1
KY	Letcher	nd	9.82	9.82	nd	1
KY	Morgan	6.28	3.90	10.97	4.06	3
KY	Owsley	nd	11.09	11.09	nd	1
KY	Perry	7.59	7.20	7.98	0.55	2
KY	Pike	10.25	4.15	26.10	6.85	8
KY	Wolfe	nd	3.77	3.77	nd	1
TN	Anderson	nd	2.90	2.90	nd	1
TN	Campbell	7.05	2.90	11.20	5.87	2
TN	Claiborne	8.61	2.30	14.04	5.92	3
VA	Wise	8.40	4.50	10.70	3.40	3
WV	Boone	nd	18.00	18.00	nd	1
WV	Nicholas	nd	5.00	5.00	nd	1

APPENDIX 11—CONTINUED

Table A11–5. Ash yield (weight percent; American Society for Testing and Materials method) means, ranges, and standard deviations for samples of the Campbell Creek/Upper Elkhorn No. 3 coal zone on an as-received whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	7.30	0.90	21.60	3.87	142
KY	na	7.67	0.90	21.60	4.41	60
VA	na	6.62	2.90	11.60	3.07	13
WV	na	7.11	1.50	17.30	3.50	69
KY	Bell	14.03	8.40	21.60	6.81	3
KY	Carter	8.00	5.04	10.95	4.18	2
KY	Clay	12.25	5.30	19.10	5.65	4
KY	Elliott	3.68	3.01	4.34	0.94	2
KY	Floyd	8.73	2.20	15.20	4.56	9
KY	Harlan	7.53	3.26	12.61	3.09	7
KY	Johnson	3.92	0.90	9.30	3.81	4
KY	Knott	nd	7.17	7.17	nd	1
KY	Lawrence	9.37	3.03	15.60	6.29	3
KY	Leslie	nd	6.20	6.20	nd	1
KY	Letcher	6.96	5.40	8.51	2.20	2
KY	Morgan	3.88	0.90	5.31	1.75	5
KY	Owsley	7.39	6.24	9.38	1.73	3
KY	Perry	nd	4.51	4.51	nd	1
KY	Pike	7.75	3.37	14.69	3.88	12
KY	Wolfe	nd	4.37	4.37	nd	1
VA	Lee	nd	4.60	4.60	nd	1
VA	Wise	6.79	2.90	11.60	3.15	12
WV	Boone	7.71	3.20	16.20	3.71	9
WV	Fayette	4.48	1.50	7.90	2.72	4
WV	Kanawha	7.50	1.90	13.10	5.05	5
WV	Logan	7.45	3.30	10.90	2.71	12
WV	Mingo	7.61	3.40	13.30	2.66	13
WV	Nicholas	6.44	2.20	10.40	3.12	9
WV	Raleigh	8.87	2.30	17.30	4.31	11
WV	Randolph	nd	3.40	3.40	nd	1
WV	Wayne	nd	7.50	7.50	nd	1
WV	Webster	2.17	1.80	2.50	0.35	3
WV	Wyoming	nd	4.30	4.30	nd	1

APPENDIX 11—CONTINUED

Table A11–6. Ash yield (weight percent; American Society for Testing and Materials method) means, ranges, and standard deviations for samples of the Upper Elkhorn Nos. 1 and 2/Powellton coal zone on an as-received whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	6.81	1.60	22.37	3.91	111
KY	na	6.35	1.60	22.37	3.74	79
TN	na	9.00	4.40	19.00	6.82	4
VA	na	8.95	6.31	11.00	1.56	6
WV	na	7.45	2.20	20.90	4.19	22
KY	Bell	4.44	1.99	8.21	2.36	5
KY	Breathitt	3.16	1.63	5.51	2.06	3
KY	Clay	7.42	2.20	16.50	5.44	9
KY	Floyd	8.77	5.49	19.10	3.96	10
KY	Harlan	5.84	1.65	9.79	3.44	4
KY	Jackson	6.17	4.22	8.12	2.76	2
KY	Knott	nd	10.39	10.39	nd	1
KY	Knox	4.51	1.60	8.42	2.29	8
KY	Laurel	7.05	6.30	8.38	0.84	5
KY	Letcher	nd	7.44	7.44	nd	1
KY	Morgan	5.48	4.44	6.51	1.46	2
KY	Owsley	7.03	5.00	9.20	2.10	3
KY	Perry	5.29	4.25	6.32	1.46	2
KY	Pike	6.12	2.08	22.37	4.52	18
KY	Whitley	5.45	2.00	11.94	4.43	4
KY	Wolfe	8.14	8.08	8.20	0.08	2
TN	Anderson	6.30	4.90	7.70	1.98	2
TN	Campbell	11.70	4.40	19.00	10.32	2
VA	Lee	9.07	8.32	9.68	0.69	3
VA	Wise	8.83	6.31	11.00	2.36	3
WV	Boone	14.05	7.20	20.90	9.69	2
WV	Fayette	6.06	4.92	7.20	1.61	2
WV	Kanawha	7.41	5.60	9.90	1.92	4
WV	Logan	4.45	3.40	5.50	1.48	2
WV	Mingo	6.83	2.20	15.70	3.99	10
WV	Raleigh	8.39	8.00	8.78	0.55	2

APPENDIX 12

SULFUR CONTENT (WEIGHT PERCENT; AMERICAN SOCIETY FOR TESTING AND MATERIALS METHOD) MEANS, RANGES, AND STANDARD DEVIATIONS FOR SAMPLES ON AN AS-RECEIVED WHOLE-COAL BASIS, BY STATE AND COUNTY, FOR EACH COAL ZONE

Table A12–1. Sulfur content (weight percent; American Society for Testing and Materials method) means, ranges, and standard deviations for samples of the No. 5 Block coal zone on an as-received whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	1.15	0.40	4.87	0.89	85
KY	na	1.42	0.41	4.87	1.12	45
WV	na	0.86	0.40	2.10	0.34	40
KY	Boyd	2.10	1.70	2.60	0.46	3
KY	Breathitt	0.80	0.56	1.76	0.35	11
KY	Carter	nd	0.80	0.80	nd	1
KY	Floyd	nd	0.65	0.65	nd	1
KY	Greenup	nd	0.80	0.80	nd	1
KY	Johnson	nd	0.69	0.69	nd	1
KY	Knott	nd	0.55	0.55	nd	1
KY	Lawrence	2.83	0.80	4.87	1.41	9
KY	Leslie	1.41	0.50	3.56	1.13	7
KY	Magoffin	0.84	0.68	0.99	0.22	2
KY	Martin	1.07	0.41	2.19	0.59	7
KY	Pike	nd	0.74	0.74	nd	1
WV	Boone	0.80	0.50	1.50	0.25	12
WV	Fayette	0.63	0.50	0.70	0.10	4
WV	Kanawha	0.98	0.40	2.10	0.44	17
WV	Logan	0.85	0.71	0.99	0.20	2
WV	Nicholas	nd	1.00	1.00	nd	1
WV	Raleigh	0.75	0.60	0.95	0.18	3
WV	Webster	nd	0.60	0.60	nd	1

APPENDIX 12—CONTINUED

Table A12–2. Sulfur content (weight percent; American Society for Testing and Materials method) means, ranges, and standard deviations for samples of the Stockton and Coalburg coal zone on an as-received whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	1.26	0.40	5.50	0.98	203
KY	na	1.38	0.40	5.50	1.05	160
VA	na	nd	0.80	0.80	nd	1
WV	na	0.83	0.40	3.20	0.47	42
KY	Bell	1.60	0.55	3.48	1.08	6
KY	Breathitt	1.28	0.60	3.13	0.77	11
KY	Carter	2.45	2.00	2.90	0.64	2
KY	Elliott	2.16	0.72	4.40	1.41	5
KY	Floyd	0.89	0.60	1.26	0.24	6
KY	Greenup	2.88	0.80	5.50	1.99	6
KY	Harlan	2.58	0.90	3.75	1.18	6
KY	Johnson	1.58	0.74	3.14	1.06	5
KY	Knott	1.05	0.60	1.50	0.36	7
KY	Knox	nd	1.68	1.68	nd	1
KY	Lawrence	0.82	0.50	1.30	0.24	14
KY	Leslie	1.76	0.50	3.43	1.00	10
KY	Magoffin	1.35	0.68	3.68	1.01	13
KY	Martin	0.86	0.40	2.22	0.36	22
KY	Morgan	1.94	0.70	2.90	1.04	5
KY	Perry	1.30	0.58	5.40	1.18	28
KY	Pike	1.10	0.59	4.04	0.92	13
VA	Wise	nd	0.80	0.80	nd	1
WV	Boone	0.82	0.50	1.60	0.40	7
WV	Fayette	nd	0.60	0.60	nd	1
WV	Kanawha	0.86	0.50	3.20	0.65	17
WV	Lincoln	nd	1.30	1.30	nd	1
WV	Logan	0.78	0.40	1.60	0.32	13
WV	Mingo	0.80	0.80	0.80	0.00	2
WV	Nicholas	nd	0.70	0.70	nd	1

APPENDIX 12—CONTINUED

Table A12–3. Sulfur content (weight percent; American Society for Testing and Materials method) means, ranges, and standard deviations for samples of the Winifrede/Hazard coal zone on an as-received whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	1.04	0.41	4.70	0.68	87
KY	na	1.16	0.41	4.70	0.77	62
TN	na	0.70	0.60	1.00	0.17	5
VA	na	0.65	0.60	0.70	0.05	3
WV	na	0.79	0.50	1.15	0.20	17
KY	Bell	1.25	0.60	2.14	0.73	4
KY	Breathitt	1.13	0.60	1.90	0.60	4
KY	Clay	1.21	0.63	1.80	0.49	8
KY	Harlan	0.92	0.60	1.40	0.42	3
KY	Johnson	nd	0.70	0.70	nd	1
KY	Knott	1.95	0.64	4.70	1.53	7
KY	Lawrence	0.63	0.59	0.70	0.06	3
KY	Leslie	0.95	0.41	2.20	0.51	11
KY	Letcher	0.88	0.70	1.00	0.15	4
KY	Magoffin	1.02	1.00	1.04	0.03	2
KY	Martin	nd	0.70	0.70	nd	1
KY	Morgan	1.42	0.80	1.97	0.59	3
KY	Owsley	nd	1.80	1.80	nd	1
KY	Perry	1.12	0.50	3.50	0.88	10
TN	Anderson	0.80	0.60	1.00	0.28	2
TN	Campbell	0.65	0.60	0.70	0.07	2
TN	Morgan	nd	0.60	0.60	nd	1
VA	Wise	0.65	0.60	0.70	0.05	3
WV	Boone	0.74	0.50	1.15	0.29	4
WV	Kanawha	0.81	0.60	1.00	0.15	7
WV	Logan	0.93	0.80	1.10	0.13	4
WV	Mingo	nd	0.60	0.60	nd	1
WV	Raleigh	nd	0.51	0.51	nd	1

APPENDIX 12—CONTINUED

Table A12–4. Sulfur content (weight percent; American Society for Testing and Materials method) means, ranges, and standard deviations for samples of the Williamson/Amburgy coal zone on an as-received whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	1.84	0.59	5.80	1.25	44
KY	na	1.97	0.59	5.80	1.23	33
TN	na	1.12	0.60	1.60	0.40	6
VA	na	1.13	0.60	2.00	0.76	3
WV	na	3.05	0.90	5.20	3.04	2
KY	Bell	0.76	0.70	0.86	0.07	5
KY	Breathitt	nd	2.40	2.40	nd	1
KY	Carter	nd	5.80	5.80	nd	1
KY	Clay	nd	2.70	2.70	nd	1
KY	Floyd	nd	3.40	3.40	nd	1
KY	Harlan	2.23	1.89	2.56	0.47	2
KY	Johnson	2.08	0.64	4.18	1.51	4
KY	Knott	nd	1.40	1.40	nd	1
KY	Lawrence	nd	0.60	0.60	nd	1
KY	Letcher	nd	0.59	0.59	nd	1
KY	Morgan	2.78	2.01	3.49	0.74	3
KY	Owsley	nd	1.94	1.94	nd	1
KY	Perry	1.28	1.16	1.39	0.16	2
KY	Pike	2.06	0.75	4.00	1.06	8
KY	Wolfe	nd	2.11	2.11	nd	1
TN	Anderson	nd	0.80	0.80	nd	1
TN	Campbell	1.15	0.90	1.40	0.35	2
TN	Claiborne	1.20	0.60	1.60	0.53	3
VA	Wise	1.13	0.60	2.00	0.76	3
WV	Boone	nd	5.20	5.20	nd	1
WV	Nicholas	nd	0.90	0.90	nd	1

APPENDIX 12—CONTINUED

Table A12–5. Sulfur content (weight percent; American Society for Testing and Materials method) means, ranges, and standard deviations for samples of the Campbell Creek/Upper Elkhorn No. 3 coal zone on an as-received whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	1.35	0.46	5.10	0.95	142
KY	na	1.74	0.46	5.10	1.20	60
VA	na	0.93	0.51	2.40	0.54	13
WV	na	1.10	0.50	3.20	0.59	69
KY	Bell	1.36	0.70	2.20	0.77	3
KY	Carter	1.81	0.71	2.90	1.55	2
KY	Clay	3.29	1.94	4.00	0.93	4
KY	Elliott	0.57	0.46	0.67	0.15	2
KY	Floyd	1.41	0.57	2.80	0.81	9
KY	Harlan	1.21	0.65	2.22	0.69	7
KY	Johnson	1.51	0.60	3.00	1.15	4
KY	Knott	nd	0.85	0.85	nd	1
KY	Lawrence	1.04	0.67	1.65	0.53	3
KY	Leslie	nd	4.00	4.00	nd	1
KY	Letcher	1.99	1.90	2.07	0.12	2
KY	Morgan	2.03	0.60	3.20	1.07	5
KY	Owsley	3.16	2.46	4.05	0.81	3
KY	Perry	nd	2.47	2.47	nd	1
KY	Pike	1.59	0.62	5.10	1.62	12
KY	Wolfe	nd	2.03	2.03	nd	1
VA	Lee	nd	0.60	0.60	nd	1
VA	Wise	0.95	0.51	2.40	0.56	12
WV	Boone	1.60	0.70	3.20	0.92	9
WV	Fayette	0.65	0.50	0.80	0.13	4
WV	Kanawha	1.14	0.50	2.60	0.84	5
WV	Logan	1.05	0.50	1.80	0.49	12
WV	Mingo	0.97	0.67	1.50	0.22	13
WV	Nicholas	1.01	0.70	1.75	0.33	9
WV	Raleigh	1.15	0.60	2.60	0.68	11
WV	Randolph	nd	0.70	0.70	nd	1
WV	Wayne	nd	2.20	2.20	nd	1
WV	Webster	0.80	0.60	1.00	0.20	3
WV	Wyoming	nd	0.60	0.60	nd	1

APPENDIX 12—CONTINUED

Table A12–6. Sulfur content (weight percent; American Society for Testing and Materials method) means, ranges, and standard deviations for samples of the Upper Elkhorn Nos. 1 and 2/Powellton coal zone on an as-received whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	1.59	0.50	6.60	1.28	111
KY	na	1.73	0.51	6.60	1.36	79
TN	na	2.38	1.10	4.50	1.49	4
VA	na	1.91	0.67	4.07	1.54	6
WV	na	0.86	0.50	1.50	0.29	22
KY	Bell	2.17	0.72	4.31	1.50	5
KY	Breathitt	1.38	0.51	2.96	1.37	3
KY	Clay	2.20	0.80	6.60	1.95	9
KY	Floyd	2.56	0.70	5.70	1.58	10
KY	Harlan	0.95	0.70	1.12	0.21	4
KY	Jackson	1.87	1.42	2.32	0.64	2
KY	Knott	nd	0.69	0.69	nd	1
KY	Knox	1.54	0.78	4.82	1.38	8
KY	Laurel	2.94	1.67	4.20	0.93	5
KY	Letcher	nd	1.27	1.27	nd	1
KY	Morgan	2.40	2.08	2.71	0.45	2
KY	Owsley	1.17	0.80	1.70	0.47	3
KY	Perry	2.23	1.76	2.69	0.66	2
KY	Pike	1.03	0.51	5.79	1.20	18
KY	Whitley	1.36	0.90	1.97	0.53	4
KY	Wolfe	1.47	1.00	1.93	0.66	2
TN	Anderson	1.40	1.10	1.70	0.42	2
TN	Campbell	3.35	2.20	4.50	1.63	2
VA	Lee	2.81	0.67	4.07	1.86	3
VA	Wise	1.01	0.80	1.12	0.18	3
WV	Boone	0.70	0.50	0.90	0.28	2
WV	Fayette	0.85	0.80	0.90	0.07	2
WV	Kanawha	0.91	0.70	1.10	0.18	4
WV	Logan	0.65	0.60	0.70	0.07	2
WV	Mingo	0.95	0.60	1.50	0.38	10
WV	Raleigh	0.70	0.60	0.80	0.14	2

APPENDIX 13

GROSS CALORIFIC VALUE (BTU/LB; AMERICAN SOCIETY FOR TESTING AND MATERIALS METHOD) MEANS, RANGES, AND STANDARD DEVIATIONS FOR SAMPLES ON AN AS-RECEIVED WHOLE-COAL BASIS, BY STATE AND COUNTY, FOR EACH COAL ZONE

Table A13–1. Gross calorific value (Btu/lb; American Society for Testing and Materials method) means, ranges, and standard deviations for samples of the No. 5 Block coal zone on an as-received whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	12,150	9,270	14,260	1,050	85
KY	na	12,000	9,270	13,300	860	45
WV	na	12,320	9,420	14,260	1,220	40
KY	Boyd	10,460	9,270	11,350	1,080	3
KY	Breathitt	12,440	11,140	13,060	620	11
KY	Carter	nd	12,450	12,450	nd	1
KY	Floyd	nd	11,680	11,680	nd	1
KY	Greenup	nd	11,250	11,250	nd	1
KY	Johnson	nd	11,830	11,830	nd	1
KY	Knott	nd	13,300	13,300	nd	1
KY	Lawrence	11,790	10,740	12,820	760	9
KY	Leslie	12,120	10,930	13,290	760	7
KY	Magoffin	12,120	12,060	12,190	90	2
KY	Martin	11,800	10,540	12,920	810	7
KY	Pike	nd	13,250	13,250	nd	1
WV	Boone	12,810	11,850	13,740	540	12
WV	Fayette	12,610	12,390	12,730	150	4
WV	Kanawha	11,820	9,420	14,260	1,670	17
WV	Logan	12,990	12,780	13,200	300	2
WV	Nicholas	nd	11,640	11,640	nd	1
WV	Raleigh	12,750	12,490	13,170	370	3
WV	Webster	nd	11,780	11,780	nd	1

APPENDIX 13—CONTINUED

Table A13–2. Gross calorific value (Btu/lb; American Society for Testing and Materials method) means, ranges, and standard deviations for samples of the Stockton and Coalburg coal zone on an as-received whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	12,340	8,700	14,330	1,020	203
KY	na	12,300	8,700	14,070	1,000	160
VA	na	nd	11,850	11,850	nd	1
WV	na	12,490	9,960	14,330	1,100	42
KY	Bell	13,160	12,050	14,070	850	6
KY	Breathitt	12,630	11,850	13,200	520	11
KY	Carter	12,620	12,320	12,920	430	2
KY	Elliott	12,270	11,010	13,010	830	5
KY	Floyd	12,200	11,490	13,470	730	6
KY	Greenup	11,380	9,450	12,820	1,240	6
KY	Harlan	12,810	12,040	13,690	600	6
KY	Johnson	11,360	9,070	12,800	1,850	5
KY	Knott	11,910	9,600	12,770	1,080	7
KY	Knox	nd	13,040	13,040	nd	1
KY	Lawrence	12,060	9,490	13,100	1,090	14
KY	Leslie	12,850	12,130	13,550	520	10
KY	Magoffin	12,450	11,390	13,720	640	13
KY	Martin	12,040	8,700	13,720	1,250	22
KY	Morgan	11,600	10,260	13,050	1,250	5
KY	Perry	12,240	10,210	13,540	870	28
KY	Pike	12,850	11,770	13,800	590	13
VA	Wise	nd	11,850	11,850	nd	1
WV	Boone	11,810	10,280	12,970	980	7
WV	Fayette	nd	12,730	12,730	nd	1
WV	Kanawha	12,680	10,260	13,900	1,050	17
WV	Lincoln	nd	13,940	13,940	nd	1
WV	Logan	12,420	9,960	14,330	1,290	13
WV	Mingo	12,770	12,560	12,980	290	2
WV	Nicholas	nd	12,680	12,680	nd	1

APPENDIX 13—CONTINUED

Table A13–3. Gross calorific value (Btu/lb; American Society for Testing and Materials method) means, ranges, and standard deviations for samples of the Winifrede/Hazard coal zone on an as-received whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	12,810	8,950	14,300	1,030	87
KY	na	12,670	8,950	14,120	1,030	62
TN	na	13,910	13,530	14,140	240	5
VA	na	13,950	13,690	14,190	250	3
WV	na	12,770	10,920	14,300	950	17
KY	Bell	12,590	11,210	13,200	930	4
KY	Breathitt	12,800	11,760	13,680	940	4
KY	Clay	12,700	11,350	13,930	920	8
KY	Harlan	13,350	13,060	13,510	250	3
KY	Johnson	nd	8,950	8,950	nd	1
KY	Knott	12,820	10,400	14,120	1,360	7
KY	Lawrence	12,970	12,850	13,080	110	3
KY	Leslie	12,770	10,960	14,100	1,030	11
KY	Letcher	12,550	12,230	13,000	330	4
KY	Magoffin	12,400	12,270	12,540	190	2
KY	Martin	nd	12,840	12,840	nd	1
KY	Morgan	11,700	10,150	13,120	1,490	3
KY	Owsley	nd	11,190	11,190	nd	1
KY	Perry	13,010	11,590	13,880	700	10
TN	Anderson	13,980	13,820	14,140	230	2
TN	Campbell	13,770	13,530	14,000	330	2
TN	Morgan	nd	14,070	14,070	nd	1
VA	Wise	13,950	13,690	14,190	250	3
WV	Boone	13,270	11,820	14,300	1,050	4
WV	Kanawha	12,700	11,460	13,550	680	7
WV	Logan	11,950	10,920	13,290	980	4
WV	Mingo	nd	13,950	13,950	nd	1
WV	Raleigh	nd	13,400	13,400	nd	1

APPENDIX 13—CONTINUED

Table A13–4. Gross calorific value (Btu/lb; American Society for Testing and Materials method) means, ranges, and standard deviations for samples of the Williamson/Amburgy coal zone on an as-received whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	13,050	10,380	14,330	830	44
KY	na	12,980	10,380	14,330	820	33
TN	na	13,300	12,310	14,330	810	6
VA	na	13,520	13,180	14,190	580	3
WV	na	12,840	11,590	14,090	1,760	2
KY	Bell	13,540	13,140	14,150	400	5
KY	Breathitt	nd	13,110	13,110	nd	1
KY	Carter	nd	11,710	11,710	nd	1
KY	Clay	nd	12,660	12,660	nd	1
KY	Floyd	nd	12,680	12,680	nd	1
KY	Harlan	13,030	12,370	13,700	940	2
KY	Johnson	13,060	12,980	13,120	70	4
KY	Knott	nd	10,570	10,570	nd	1
KY	Lawrence	nd	12,820	12,820	nd	1
KY	Letcher	nd	13,580	13,580	nd	1
KY	Morgan	12,980	12,400	13,360	510	3
KY	Owsley	nd	12,700	12,700	nd	1
KY	Perry	13,320	13,310	13,320	0	2
KY	Pike	12,930	10,380	14,330	1,160	8
KY	Wolfe	nd	13,420	13,420	nd	1
TN	Anderson	nd	13,760	13,760	nd	1
TN	Campbell	13,060	12,310	13,810	1,060	2
TN	Claiborne	13,300	12,420	14,330	960	3
VA	Wise	13,520	13,180	14,190	580	3
WV	Boone	nd	11,590	11,590	nd	1
WV	Nicholas	nd	14,090	14,090	nd	1

APPENDIX 13—CONTINUED

Table A13–5. Gross calorific value (Btu/lb; American Society for Testing and Materials method) means, ranges, and standard deviations for samples of the Campbell Creek/Upper Elkhorn No. 3 coal zone on an as-received whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	13,460	9,940	15,000	780	142
KY	na	13,190	11,210	14,360	730	60
VA	na	13,870	13,030	14,450	450	13
WV	na	13,620	9,940	15,000	790	69
KY	Bell	12,580	11,210	13,830	1,310	3
KY	Carter	12,300	12,010	12,590	410	2
KY	Clay	12,860	11,530	13,940	1,000	4
KY	Elliott	12,840	12,820	12,850	20	2
KY	Floyd	13,060	11,830	14,310	870	9
KY	Harlan	13,520	12,610	14,230	510	7
KY	Johnson	12,970	12,310	13,350	480	4
KY	Knott	nd	13,370	13,370	nd	1
KY	Lawrence	12,490	11,480	13,500	1,010	3
KY	Leslie	nd	13,800	13,800	nd	1
KY	Letcher	13,670	13,510	13,840	240	2
KY	Morgan	13,370	13,120	13,550	170	5
KY	Owsley	13,080	13,010	13,180	90	3
KY	Perry	nd	13,950	13,950	nd	1
KY	Pike	13,530	12,560	14,360	680	12
KY	Wolfe	nd	13,280	13,280	nd	1
VA	Lee	nd	14,290	14,290	nd	1
VA	Wise	13,830	13,030	14,450	450	12
WV	Boone	13,380	12,160	14,100	610	9
WV	Fayette	13,250	9,940	15,000	2,280	4
WV	Kanawha	13,600	12,430	14,460	870	5
WV	Logan	13,550	12,180	14,540	650	12
WV	Mingo	13,500	12,180	14,510	630	13
WV	Nicholas	13,750	12,990	14,480	490	9
WV	Raleigh	13,770	12,630	14,810	710	11
WV	Randolph	nd	14,320	14,320	nd	1
WV	Wayne	nd	13,110	13,110	nd	1
WV	Webster	14,430	14,220	14,570	190	3
WV	Wyoming	nd	14,280	14,280	nd	1

APPENDIX 13—CONTINUED

Table A13–6. Gross calorific value (Btu/lb; American Society for Testing and Materials method) means, ranges, and standard deviations for samples of the Upper Elkhorn Nos. 1 and 2/Powellton coal zone on an as-received whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	13,530	11,120	14,630	740	111
KY	na	13,530	11,120	14,630	740	79
TN	na	13,380	12,350	13,950	710	4
VA	na	13,200	12,590	14,030	530	6
WV	na	13,680	11,290	14,510	790	22
KY	Bell	14,150	13,630	14,380	300	5
KY	Breathitt	12,920	11,390	13,850	1,330	3
KY	Clay	13,520	11,990	14,550	870	9
KY	Floyd	13,090	11,380	13,790	690	10
KY	Harlan	13,890	13,310	14,480	500	4
KY	Jackson	13,050	12,680	13,420	520	2
KY	Knott	nd	13,240	13,240	nd	1
KY	Knox	13,680	12,910	14,220	420	8
KY	Laurel	13,300	13,130	13,440	130	5
KY	Letcher	nd	13,750	13,750	nd	1
KY	Morgan	12,990	12,820	13,160	240	2
KY	Owsley	12,990	12,220	13,710	750	3
KY	Perry	14,060	14,050	14,070	20	2
KY	Pike	13,880	11,120	14,630	810	18
KY	Whitley	13,400	12,260	13,940	770	4
KY	Wolfe	12,670	12,480	12,870	270	2
TN	Anderson	13,780	13,610	13,950	240	2
TN	Campbell	12,970	12,350	13,600	890	2
VA	Lee	12,850	12,590	13,070	250	3
VA	Wise	13,550	12,990	14,030	520	3
WV	Boone	12,330	11,290	13,370	1,470	2
WV	Fayette	14,280	14,100	14,450	240	2
WV	Kanawha	13,670	13,270	13,950	290	4
WV	Logan	14,380	14,250	14,510	190	2
WV	Mingo	13,730	12,340	14,470	760	10
WV	Raleigh	13,530	13,260	13,790	370	2

APPENDIX 14

SULFUR–DIOXIDE (SO_2) CONTENT (LBS/MILLION BTU) MEANS, RANGES, AND STANDARD DEVIATIONS FOR SAMPLES ON AN AS-RECEIVED WHOLE-COAL BASIS, BY STATE AND COUNTY, FOR EACH COAL ZONE

Table A14–1. Sulfur-dioxide (SO_2) content (lbs/million Btu) means, ranges, and standard deviations for samples of the No. 5 Block coal zone on an as-received whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	1.93	0.76	8.97	1.54	85
KY	na	2.40	0.78	8.97	1.94	45
WV	na	1.40	0.76	3.09	0.54	40
KY	Boyd	4.10	3.16	5.61	1.32	3
KY	Breathitt	1.28	0.89	2.73	0.54	11
KY	Carter	nd	1.29	1.29	nd	1
KY	Floyd	nd	1.11	1.11	nd	1
KY	Greenup	nd	1.42	1.42	nd	1
KY	Johnson	nd	1.17	1.17	nd	1
KY	Knott	nd	0.83	0.83	nd	1
KY	Lawrence	4.79	1.37	8.97	2.42	9
KY	Leslie	2.33	0.82	5.68	1.83	7
KY	Magoffin	1.38	1.12	1.64	0.37	2
KY	Martin	1.78	0.78	3.39	0.87	7
KY	Pike	nd	1.12	1.12	nd	1
WV	Boone	1.25	0.76	2.43	0.41	12
WV	Fayette	0.99	0.81	1.11	0.14	4
WV	Kanawha	1.65	0.80	3.09	0.65	17
WV	Logan	1.31	1.11	1.50	0.28	2
WV	Nicholas	nd	1.72	1.72	nd	1
WV	Raleigh	1.18	0.96	1.51	0.29	3
WV	Webster	nd	1.02	1.02	nd	1

APPENDIX 14—CONTINUED

Table A14–2. Sulfur-dioxide (SO_2) content (lbs/million Btu) means, ranges, and standard deviations for samples of the Stockton and Coalburg coal zone on an as-received whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	2.07	0.70	9.95	1.68	203
KY	na	2.27	0.75	9.95	1.80	160
VA	na	nd	1.35	1.35	nd	1
WV	na	1.33	0.70	5.34	0.77	42
KY	Bell	2.49	0.78	5.47	1.74	6
KY	Breathitt	2.02	0.99	4.82	1.19	11
KY	Carter	3.90	3.10	4.71	1.14	2
KY	Elliott	3.59	1.15	7.40	2.44	5
KY	Floyd	1.46	0.89	2.01	0.40	6
KY	Greenup	5.33	1.32	9.95	3.93	6
KY	Harlan	4.06	1.40	5.64	1.89	6
KY	Johnson	2.82	1.16	5.03	1.83	5
KY	Knott	1.76	0.96	2.35	0.54	7
KY	Knox	nd	2.58	2.58	nd	1
KY	Lawrence	1.36	0.93	2.02	0.36	14
KY	Leslie	2.76	0.75	5.08	1.56	10
KY	Magoffin	2.22	1.04	6.46	1.76	13
KY	Martin	1.43	0.88	3.78	0.59	22
KY	Morgan	3.45	1.19	5.58	1.99	5
KY	Perry	2.12	0.90	9.11	1.95	28
KY	Pike	1.71	0.89	6.25	1.43	13
VA	Wise	nd	1.35	1.35	nd	1
WV	Boone	1.37	0.84	2.47	0.58	7
WV	Fayette	nd	0.94	0.94	nd	1
WV	Kanawha	1.37	0.87	5.34	1.08	17
WV	Lincoln	nd	1.87	1.87	nd	1
WV	Logan	1.27	0.70	2.50	0.51	13
WV	Mingo	1.25	1.23	1.27	0.03	2
WV	Nicholas	nd	1.10	1.10	nd	1

APPENDIX 14—CONTINUED

Table A14–3. Sulfur-dioxide (SO_2) content (lbs/million Btu) means, ranges, and standard deviations for samples of the Winifrede/Hazard coal zone on an as-received whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	1.67	0.75	7.33	1.16	87
KY	na	1.87	0.75	7.33	1.30	62
TN	na	1.01	0.85	1.45	0.25	5
VA	na	0.94	0.86	1.02	0.08	3
WV	na	1.26	0.75	1.95	0.38	17
KY	Bell	1.94	1.07	3.24	1.06	4
KY	Breathitt	1.77	1.02	3.10	0.98	4
KY	Clay	1.95	0.90	3.10	0.90	8
KY	Harlan	1.39	0.89	2.14	0.67	3
KY	Johnson	nd	1.56	1.56	nd	1
KY	Knott	3.17	0.91	7.33	2.50	7
KY	Lawrence	0.97	0.92	1.08	0.09	3
KY	Leslie	1.49	0.75	3.56	0.83	11
KY	Letcher	1.39	1.14	1.59	0.21	4
KY	Magoffin	1.64	1.63	1.66	0.02	2
KY	Martin	nd	1.09	1.09	nd	1
KY	Morgan	2.50	1.22	3.33	1.13	3
KY	Owsley	nd	3.22	3.22	nd	1
KY	Perry	1.77	0.83	6.04	1.56	10
TN	Anderson	1.15	0.85	1.45	0.42	2
TN	Campbell	0.94	0.89	1.00	0.08	2
TN	Morgan	nd	0.85	0.85	nd	1
VA	Wise	0.94	0.86	1.02	0.08	3
WV	Boone	1.14	0.75	1.95	0.55	4
WV	Kanawha	1.28	0.92	1.64	0.26	7
WV	Logan	1.55	1.35	1.87	0.22	4
WV	Mingo	nd	0.86	0.86	nd	1
WV	Raleigh	nd	0.76	0.76	nd	1

APPENDIX 14—CONTINUED

Table A14–4. Sulfur-dioxide (SO_2) content (lbs/million Btu) means, ranges, and standard deviations for samples of the Williamson/Amburgy coal zone on an as-received whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	2.91	0.84	9.91	2.15	44
KY	na	3.11	0.87	9.91	2.10	33
TN	na	1.72	0.84	2.58	0.70	6
VA	na	1.70	0.85	3.03	1.17	3
WV	na	5.12	1.28	8.97	5.44	2
KY	Bell	1.12	1.06	1.22	0.07	5
KY	Breathitt	nd	3.66	3.66	nd	1
KY	Carter	nd	9.91	9.91	nd	1
KY	Clay	nd	4.27	4.27	nd	1
KY	Floyd	nd	5.36	5.36	nd	1
KY	Harlan	3.40	3.06	3.74	0.48	2
KY	Johnson	3.19	0.98	6.42	2.31	4
KY	Knott	nd	2.65	2.65	nd	1
KY	Lawrence	nd	0.94	0.94	nd	1
KY	Letcher	nd	0.87	0.87	nd	1
KY	Morgan	4.31	3.01	5.63	1.31	3
KY	Owsley	nd	3.06	3.06	nd	1
KY	Perry	1.92	1.74	2.09	0.24	2
KY	Pike	3.34	1.05	7.71	2.08	8
KY	Wolfe	nd	3.15	3.15	nd	1
TN	Anderson	nd	1.16	1.16	nd	1
TN	Campbell	1.79	1.30	2.27	0.69	2
TN	Claiborne	1.85	0.84	2.58	0.91	3
VA	Wise	1.70	0.85	3.03	1.17	3
WV	Boone	nd	8.97	8.97	nd	1
WV	Nicholas	nd	1.28	1.28	nd	1

APPENDIX 14—CONTINUED

Table A14–5. Sulfur-dioxide (SO_2) content (lbs/million Btu) means, ranges, and standard deviations for samples of the Campbell Creek/Upper Elkhorn No. 3 coal zone on an as-received whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	2.04	0.70	7.92	1.48	142
KY	na	2.66	0.72	7.92	1.86	60
VA	na	1.35	0.71	3.68	0.85	13
WV	na	1.62	0.70	4.65	0.91	69
KY	Bell	2.24	1.10	3.93	1.49	3
KY	Carter	2.98	1.13	4.83	2.62	2
KY	Clay	5.06	3.37	6.15	1.26	4
KY	Elliott	0.88	0.72	1.04	0.23	2
KY	Floyd	2.23	0.87	4.73	1.41	9
KY	Harlan	1.81	0.98	3.52	1.06	7
KY	Johnson	2.36	0.90	4.88	1.88	4
KY	Knott	nd	1.27	1.27	nd	1
KY	Lawrence	1.68	0.99	2.64	0.86	3
KY	Leslie	nd	5.80	5.80	nd	1
KY	Letcher	2.91	2.75	3.07	0.23	2
KY	Morgan	3.03	0.90	4.72	1.59	5
KY	Owsley	4.84	3.73	6.20	1.26	3
KY	Perry	nd	3.54	3.54	nd	1
KY	Pike	2.40	0.87	7.92	2.53	12
KY	Wolfe	nd	3.06	3.06	nd	1
VA	Lee	nd	0.84	0.84	nd	1
VA	Wise	1.40	0.71	3.68	0.87	12
WV	Boone	2.41	1.00	4.65	1.38	9
WV	Fayette	0.99	0.80	1.17	0.15	4
WV	Kanawha	1.72	0.76	4.18	1.40	5
WV	Logan	1.56	0.70	2.65	0.73	12
WV	Mingo	1.45	0.98	2.18	0.32	13
WV	Nicholas	1.47	1.05	2.59	0.50	9
WV	Raleigh	1.68	0.95	3.98	1.03	11
WV	Randolph	nd	0.98	0.98	nd	1
WV	Wayne	nd	3.36	3.36	nd	1
WV	Webster	1.11	0.84	1.37	0.26	3
WV	Wyoming	nd	0.84	0.84	nd	1

APPENDIX 14—CONTINUED

Table A14–6. Sulfur-dioxide (SO_2) content (lbs/million Btu) means, ranges, and standard deviations for samples of the Upper Elkhorn Nos. 1 and 2/Powellton coal zone on an as-received whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	2.39	0.72	11.01	2.01	111
KY	na	2.60	0.72	11.01	2.12	79
TN	na	3.65	1.58	7.29	2.52	4
VA	na	2.93	1.04	6.23	2.43	6
WV	na	1.26	0.83	2.43	0.45	22
KY	Bell	3.10	1.00	6.32	2.21	5
KY	Breathitt	2.09	0.90	4.38	1.99	3
KY	Clay	3.38	1.12	11.01	3.27	9
KY	Floyd	3.89	1.05	8.84	2.40	10
KY	Harlan	1.38	0.97	1.64	0.31	4
KY	Jackson	2.89	2.12	3.66	1.09	2
KY	Knott	nd	1.04	1.04	nd	1
KY	Knox	2.29	1.10	7.47	2.17	8
KY	Laurel	4.41	2.54	6.27	1.37	5
KY	Letcher	nd	1.85	1.85	nd	1
KY	Morgan	3.68	3.25	4.12	0.62	2
KY	Owsley	1.78	1.23	2.48	0.64	3
KY	Perry	3.16	2.51	3.82	0.93	2
KY	Pike	1.53	0.72	8.95	1.88	18
KY	Whitley	2.07	1.29	3.22	0.92	4
KY	Wolfe	2.30	1.60	3.00	0.99	2
TN	Anderson	2.04	1.58	2.50	0.65	2
TN	Campbell	5.26	3.24	7.29	2.87	2
VA	Lee	4.38	1.04	6.23	2.90	3
VA	Wise	1.48	1.23	1.64	0.22	3
WV	Boone	1.12	0.89	1.35	0.33	2
WV	Fayette	1.19	1.11	1.28	0.12	2
WV	Kanawha	1.33	1.06	1.59	0.25	4
WV	Logan	0.90	0.83	0.98	0.11	2
WV	Mingo	1.40	0.83	2.43	0.61	10
WV	Raleigh	1.04	0.87	1.21	0.24	2

APPENDIX 15

ARSENIC CONTENT (PARTS PER MILLION) MEANS, RANGES, AND STANDARD DEVIATIONS FOR SAMPLES ON A REMNANT-MOISTURE WHOLE-COAL BASIS, BY STATE AND COUNTY, FOR EACH COAL ZONE

Table A15–1. Arsenic content (parts per million) means, ranges, and standard deviations for samples of the No. 5 Block coal zone on a remnant-moisture whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	14	0.75	150	24	92
KY	na	19	0.75	150	31	47
WV	na	9.0	0.80	49	11	45
KY	Boyd	11	8.9	13	2.9	2
KY	Breathitt	4.9	0.90	16	5.3	11
KY	Carter	nd	9.0	9.0	nd	1
KY	Floyd	nd	2.5	2.5	nd	1
KY	Greenup	nd	7.1	7.1	nd	1
KY	Johnson	nd	4.4	4.4	nd	1
KY	Knott	nd	1.0	1.0	nd	1
KY	Lawrence	39	2.5	140	38	12
KY	Leslie	29	0.75	150	54	7
KY	Magoffin	3.4	2.2	4.6	1.7	2
KY	Martin	17	1.5	45	18	7
KY	Pike	nd	2.3	2.3	nd	1
WV	Boone	7.1	0.80	36	10	12
WV	Fayette	1.7	1.4	2.5	0.47	5
WV	Kanawha	14	1.2	49	13	20
WV	Logan	3.0	2.0	4.0	4.1	2
WV	Nicholas	nd	5.9	5.9	nd	1
WV	Raleigh	1.0	0.88	1.3	0.24	3
WV	Wayne	nd	19	19	nd	1
WV	Webster	nd	1.3	1.3	nd	1

APPENDIX 15—CONTINUED

Table A15–2. Arsenic content (parts per million) means, ranges, and standard deviations for samples of the Stockton and Coalburg coal zone on a remnant-moisture whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	14	0.40	170	22	205
KY	na	17	0.60	170	24	162
VA	na	nd	2.6	2.6	nd	1
WV	na	4.9	0.40	38	7.3	42
KY	Bell	19	2.0	47	16	6
KY	Breathitt	6.3	1.5	18	5.3	11
KY	Carter	8.8	3.5	14	7.4	2
KY	Elliott	29	2.9	77	32	5
KY	Floyd	8.3	0.60	28	10	6
KY	Greenup	30	2.3	60	25	6
KY	Harlan	36	5.8	79	28	6
KY	Johnson	22	1.7	77	32	5
KY	Knott	17	1.7	50	17	7
KY	Knox	nd	16	16	nd	1
KY	Lawrence	6.9	1.0	35	8.6	15
KY	Leslie	15	0.60	37	12	12
KY	Magoffin	26	1.0	170	49	13
KY	Martin	11	0.60	43	12	22
KY	Morgan	22	5.1	49	20	5
KY	Perry	17	0.80	150	30	27
KY	Pike	16	1.4	95	25	13
VA	Wise	nd	2.6	2.6	nd	1
WV	Boone	7.8	0.70	28	10	7
WV	Fayette	nd	2.1	2.1	nd	1
WV	Kanawha	3.2	0.80	13	3.9	17
WV	Lincoln	nd	7.7	7.7	nd	1
WV	Logan	5.7	0.40	38	10	13
WV	Mingo	5.4	4.7	6.0	0.92	2
WV	Nicholas	nd	1.6	1.6	nd	1

APPENDIX 15—CONTINUED

Table A15–3. Arsenic content (parts per million) means, ranges, and standard deviations for samples of the Winifrede/Hazard coal zone on a remnant-moisture whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	15	0.40	270	37	90
KY	na	19	0.40	270	43	65
TN	na	1.8	1.1	2.7	0.76	5
VA	na	2.8	2.4	3.0	0.35	3
WV	na	3.7	0.50	10	2.8	17
KY	Bell	18	2.5	52	23	4
KY	Breathitt	8.2	1.2	17	7.6	4
KY	Clay	19	1.7	58	23	8
KY	Harlan	12	4.4	27	13	3
KY	Johnson	nd	6.5	6.5	nd	1
KY	Knott	60	0.40	270	100	9
KY	Lawrence	4.1	3.1	5.0	1.3	2
KY	Leslie	10	1.6	36	10	13
KY	Letcher	12	4.5	27	10	4
KY	Magoffin	13	4.8	22	12	2
KY	Martin	nd	5.3	5.3	nd	1
KY	Morgan	11	1.5	19	8.8	3
KY	Owsley	nd	11	11	nd	1
KY	Perry	16	1.2	100	30	10
TN	Anderson	1.2	1.1	1.3	0.14	2
TN	Campbell	2.6	2.5	2.7	0.14	2
TN	Morgan	nd	1.3	1.3	nd	1
VA	Wise	2.8	2.4	3.0	0.35	3
WV	Boone	2.8	0.50	7.5	3.2	4
WV	Kanawha	3.1	1.5	6.0	1.6	7
WV	Logan	6.9	5.0	10	2.4	4
WV	Mingo	nd	1.6	1.6	nd	1
WV	Raleigh	nd	0.70	0.70	nd	1

APPENDIX 15—CONTINUED

Table A15–4. Arsenic content (parts per million) means, ranges, and standard deviations for samples of the Williamson/Amburgy coal zone on a remnant-moisture whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	29	0.61	170	35	45
KY	na	34	0.61	170	39	34
TN	na	11	0.80	23	7.7	6
VA	na	11	0.90	31	17	3
WV	na	23	20	26	4.2	2
KY	Bell	5.6	1.9	11	3.7	5
KY	Breathitt	nd	28	28	nd	1
KY	Carter	nd	170	170	nd	1
KY	Clay	43	37	48	7.8	2
KY	Floyd	nd	29	29	nd	1
KY	Harlan	87	73	100	19	2
KY	Johnson	21	0.61	49	23	4
KY	Knott	nd	66	66	nd	1
KY	Lawrence	nd	2.0	2.0	nd	1
KY	Letcher	nd	2.1	2.1	nd	1
KY	Morgan	32	16	57	22	3
KY	Owsley	nd	27	27	nd	1
KY	Perry	12	1.7	23	15	2
KY	Pike	30	1.8	120	39	8
KY	Wolfe	nd	87	87	nd	1
TN	Anderson	nd	7.8	7.8	nd	1
TN	Campbell	9.8	5.6	14	5.9	2
TN	Claiborne	12	0.80	23	11	3
VA	Wise	11	0.90	31	17	3
WV	Boone	nd	26	26	nd	1
WV	Nicholas	nd	20	20	nd	1

APPENDIX 15—CONTINUED

Table A15–5. Arsenic content (parts per million) means, ranges, and standard deviations for samples of the Campbell Creek/Upper Elkhorn No. 3 coal zone on a remnant-moisture whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	17	0.85	170	26	142
KY	na	27	1.1	170	34	60
VA	na	15	1.7	85	23	13
WV	na	8.7	0.85	75	12	69
KY	Bell	34	7.6	65	29	3
KY	Carter	19	3.3	35	22	2
KY	Clay	44	20	83	27	4
KY	Elliott	2.4	1.7	3.0	0.92	2
KY	Floyd	8.2	1.5	19	5.0	9
KY	Harlan	36	1.6	77	31	7
KY	Johnson	11	1.1	32	14	5
KY	Knott	nd	7.8	7.8	nd	1
KY	Lawrence	23	2.2	43	29	2
KY	Leslie	nd	34	34	nd	1
KY	Letcher	24	16	31	11	2
KY	Morgan	19	2.6	39	17	5
KY	Owsley	65	40	110	39	3
KY	Perry	nd	11	11	nd	1
KY	Pike	31	1.5	170	57	12
KY	Wolfe	nd	79	79	nd	1
VA	Lee	nd	2.0	2.0	nd	1
VA	Wise	16	1.7	85	24	12
WV	Boone	13	0.90	37	13	9
WV	Fayette	2.4	1.5	3.6	0.90	4
WV	Kanawha	10	1.9	18	6.2	5
WV	Logan	11	0.85	75	21	12
WV	Mingo	4.5	0.90	13	4.0	13
WV	Nicholas	10	1.1	34	10	9
WV	Raleigh	9.7	1.5	53	15	11
WV	Randolph	nd	1.4	1.4	nd	1
WV	Wayne	nd	12	12	nd	1
WV	Webster	7.5	1.3	16	7.6	3
WV	Wyoming	nd	1.0	1.0	nd	1

APPENDIX 15—CONTINUED

Table A15–6. Arsenic content (parts per million) means, ranges, and standard deviations for samples of the Upper Elkhorn Nos. 1 and 2/Powellton coal zone on a remnant-moisture whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	42	0.80	680	90	114
KY	na	52	0.90	680	100	81
TN	na	68	7.7	160	65	4
VA	na	11	1.7	23	9.5	6
WV	na	12	0.80	70	18	23
KY	Bell	32	1.4	96	41	5
KY	Breathitt	21	15	27	6.0	3
KY	Clay	120	3.6	420	150	11
KY	Floyd	34	6.4	110	33	10
KY	Harlan	9.5	1.6	20	8.6	4
KY	Jackson	60	20	100	57	2
KY	Knott	nd	13	13	nd	1
KY	Knox	100	2.7	680	230	8
KY	Laurel	130	25	280	110	5
KY	Letcher	nd	11	11	nd	1
KY	Morgan	66	33	99	47	2
KY	Owsley	22	11	44	19	3
KY	Perry	27	9.6	45	25	2
KY	Pike	16	0.90	140	34	18
KY	Whitley	28	2.8	83	37	4
KY	Wolfe	23	11	34	16	2
TN	Anderson	28	7.7	48	28	2
TN	Campbell	110	58	160	72	2
VA	Lee	16	1.7	23	12	3
VA	Wise	5.9	3.2	9.9	3.5	3
WV	Boone	4.9	4.1	6.2	1.1	3
WV	Fayette	28	3.9	53	35	2
WV	Kanawha	11	4.8	18	6.1	4
WV	Logan	4.3	0.80	7.8	4.9	2
WV	Mingo	14	1.1	70	23	10
WV	Raleigh	1.6	1.1	2.0	0.64	2

APPENDIX 16

MERCURY CONTENT (PARTS PER MILLION) MEANS, RANGES, AND STANDARD DEVIATIONS FOR SAMPLES ON A REMNANT-MOISTURE WHOLE-COAL BASIS, BY STATE AND COUNTY, FOR EACH COAL ZONE

Table A16–1. Mercury content (parts per million) means, ranges, and standard deviations for samples of the No. 5 Block coal zone on a remnant-moisture whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	0.18	0.023	1.5	0.18	93
KY	na	0.20	0.024	1.5	0.23	48
WV	na	0.16	0.023	0.49	0.11	45
KY	Boyd	0.29	0.17	0.36	0.11	3
KY	Breathitt	0.092	0.028	0.30	0.082	11
KY	Carter	nd	0.10	0.10	nd	1
KY	Floyd	nd	0.14	0.14	nd	1
KY	Greenup	nd	0.52	0.52	nd	1
KY	Johnson	nd	0.10	0.10	nd	1
KY	Knott	nd	0.050	0.050	nd	1
KY	Lawrence	0.35	0.11	1.5	0.38	12
KY	Leslie	0.12	0.024	0.33	0.11	7
KY	Magoffin	0.25	0.24	0.26	0.014	2
KY	Martin	0.17	0.083	0.30	0.089	7
KY	Pike	nd	0.055	0.055	nd	1
WV	Boone	0.15	0.051	0.33	0.080	12
WV	Fayette	0.15	0.048	0.25	0.094	5
WV	Kanawha	0.19	0.080	0.49	0.12	20
WV	Logan	0.071	0.047	0.094	0.033	2
WV	Nicholas	nd	0.25	0.25	nd	1
WV	Raleigh	0.032	0.023	0.048	0.014	3
WV	Wayne	nd	0.36	0.36	nd	1
WV	Webster	nd	0.025	0.025	nd	1

APPENDIX 16—CONTINUED

Table A16–2. Mercury content (parts per million) means, ranges, and standard deviations for samples of the Stockton and Coalburg coal zone on a remnant-moisture whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	0.15	0.0070	0.67	0.13	206
KY	na	0.17	0.015	0.62	0.13	163
VA	na	nd	0.090	0.090	nd	1
WV	na	0.097	0.0070	0.67	0.11	42
KY	Bell	0.15	0.060	0.31	0.093	6
KY	Breathitt	0.23	0.080	0.41	0.11	11
KY	Carter	0.061	0.052	0.070	0.013	2
KY	Elliott	0.14	0.075	0.25	0.068	5
KY	Floyd	0.22	0.060	0.59	0.20	6
KY	Greenup	0.22	0.14	0.36	0.079	6
KY	Harlan	0.16	0.030	0.52	0.18	6
KY	Johnson	0.085	0.036	0.15	0.045	5
KY	Knott	0.19	0.032	0.37	0.13	7
KY	Knox	nd	0.060	0.060	nd	1
KY	Lawrence	0.13	0.020	0.39	0.091	15
KY	Leslie	0.20	0.027	0.62	0.18	12
KY	Magoffin	0.21	0.040	0.44	0.13	13
KY	Martin	0.15	0.019	0.50	0.13	22
KY	Morgan	0.26	0.040	0.45	0.16	5
KY	Perry	0.15	0.015	0.46	0.13	28
KY	Pike	0.12	0.030	0.34	0.090	13
VA	Wise	nd	0.090	0.090	nd	1
WV	Boone	0.14	0.020	0.67	0.23	7
WV	Fayette	nd	0.088	0.088	nd	1
WV	Kanawha	0.062	0.0070	0.31	0.078	17
WV	Lincoln	nd	0.17	0.17	nd	1
WV	Logan	0.11	0.010	0.26	0.072	13
WV	Mingo	0.12	0.070	0.16	0.064	2
WV	Nicholas	nd	0.080	0.080	nd	1

APPENDIX 16—CONTINUED

Table A16–3. Mercury content (parts per million) means, ranges, and standard deviations for samples of the Winifrede/Hazard coal zone on a remnant-moisture whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	0.15	0.0070	1.0	0.17	90
KY	na	0.18	0.0070	1.0	0.18	65
TN	na	0.048	0.0070	0.12	0.047	5
VA	na	0.063	0.030	0.12	0.049	3
WV	na	0.074	0.0070	0.28	0.063	17
KY	Bell	0.086	0.020	0.26	0.12	4
KY	Breathitt	0.16	0.0070	0.29	0.12	4
KY	Clay	0.16	0.020	0.55	0.19	8
KY	Harlan	0.10	0.020	0.22	0.10	3
KY	Johnson	nd	0.098	0.098	nd	1
KY	Knott	0.31	0.020	1.0	0.35	9
KY	Lawrence	0.060	0.020	0.10	0.057	2
KY	Leslie	0.19	0.040	0.48	0.12	13
KY	Letcher	0.051	0.030	0.065	0.015	4
KY	Magoffin	0.20	0.046	0.35	0.21	2
KY	Martin	nd	0.45	0.45	nd	1
KY	Morgan	0.16	0.060	0.25	0.095	3
KY	Owsley	nd	0.18	0.18	nd	1
KY	Perry	0.16	0.0070	0.43	0.15	10
TN	Anderson	0.0070	0.0070	0.0070	0	2
TN	Campbell	0.093	0.065	0.12	0.039	2
TN	Morgan	nd	0.042	0.042	nd	1
VA	Wise	0.063	0.030	0.12	0.049	3
WV	Boone	0.068	0.038	0.12	0.037	4
WV	Kanawha	0.089	0.023	0.28	0.089	7
WV	Logan	0.071	0.030	0.13	0.043	4
WV	Mingo	nd	0.080	0.080	nd	1
WV	Raleigh	nd	0.0070	0.0070	nd	1

APPENDIX 16—CONTINUED

Table A16–4. Mercury content (parts per million) means, ranges, and standard deviations for samples of the Williamson/Amburgy coal zone on a remnant-moisture whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	0.14	0.010	0.49	0.11	45
KY	na	0.14	0.020	0.35	0.097	34
TN	na	0.13	0.010	0.32	0.13	6
VA	na	0.052	0.012	0.12	0.059	3
WV	na	0.29	0.091	0.49	0.28	2
KY	Bell	0.14	0.020	0.26	0.11	5
KY	Breathitt	nd	0.090	0.090	nd	1
KY	Carter	nd	0.068	0.068	nd	1
KY	Clay	0.19	0.050	0.32	0.19	2
KY	Floyd	nd	0.27	0.27	nd	1
KY	Harlan	0.23	0.21	0.24	0.021	2
KY	Johnson	0.14	0.035	0.22	0.078	4
KY	Knott	nd	0.24	0.24	nd	1
KY	Lawrence	nd	0.030	0.030	nd	1
KY	Letcher	nd	0.13	0.13	nd	1
KY	Morgan	0.092	0.045	0.18	0.077	3
KY	Owsley	nd	0.17	0.17	nd	1
KY	Perry	0.040	0.020	0.060	0.028	2
KY	Pike	0.14	0.040	0.35	0.11	8
KY	Wolfe	nd	0.045	0.045	nd	1
TN	Anderson	nd	0.038	0.038	nd	1
TN	Campbell	0.096	0.042	0.15	0.076	2
TN	Claiborne	0.19	0.010	0.32	0.16	3
VA	Wise	0.052	0.012	0.12	0.059	3
WV	Boone	nd	0.49	0.49	nd	1
WV	Nicholas	nd	0.091	0.091	nd	1

APPENDIX 16—CONTINUED

Table A16–5. Mercury content (parts per million) means, ranges, and standard deviations for samples of the Campbell Creek/Upper Elkhorn No. 3 coal zone on a remnant-moisture whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	0.13	0.0070	0.72	0.12	142
KY	na	0.14	0.0070	0.66	0.12	60
VA	na	0.12	0.052	0.30	0.066	13
WV	na	0.12	0.0070	0.72	0.13	69
KY	Bell	0.12	0.046	0.18	0.067	3
KY	Carter	0.15	0.095	0.21	0.081	2
KY	Clay	0.31	0.21	0.52	0.14	4
KY	Elliott	0.12	0.062	0.17	0.076	2
KY	Floyd	0.19	0.060	0.66	0.19	9
KY	Harlan	0.11	0.060	0.16	0.034	7
KY	Johnson	0.085	0.0070	0.22	0.10	5
KY	Knott	nd	0.080	0.080	nd	1
KY	Lawrence	0.13	0.030	0.23	0.14	2
KY	Leslie	nd	0.19	0.19	nd	1
KY	Letcher	0.25	0.075	0.43	0.25	2
KY	Morgan	0.066	0.0070	0.17	0.062	5
KY	Owsley	0.18	0.050	0.31	0.13	3
KY	Perry	nd	0.050	0.050	nd	1
KY	Pike	0.093	0.040	0.24	0.069	12
KY	Wolfe	nd	0.16	0.16	nd	1
VA	Lee	nd	0.16	0.16	nd	1
VA	Wise	0.11	0.052	0.30	0.067	12
WV	Boone	0.20	0.010	0.72	0.23	9
WV	Fayette	0.046	0.013	0.091	0.033	4
WV	Kanawha	0.10	0.010	0.27	0.10	5
WV	Logan	0.13	0.0070	0.42	0.14	12
WV	Mingo	0.082	0.010	0.22	0.066	13
WV	Nicholas	0.099	0.042	0.17	0.039	9
WV	Raleigh	0.17	0.020	0.37	0.14	11
WV	Randolph	nd	0.055	0.055	nd	1
WV	Wayne	nd	0.29	0.29	nd	1
WV	Webster	0.038	0.014	0.080	0.036	3
WV	Wyoming	nd	0.10	0.10	nd	1

APPENDIX 16—CONTINUED

Table A16–6. Mercury content (parts per million) means, ranges, and standard deviations for samples of the Upper Elkhorn Nos. 1 and 2/Powellton coal zone on a remnant-moisture whole-coal basis, by State and county.

[Data are compiled from Appendix 10. na, not applicable; nd, no data. Source: Bragg and others (1998).]

State	County	Mean	Minimum	Maximum	Standard deviation	Number of samples
ALL	na	0.16	0.0070	0.81	0.14	114
KY	na	0.17	0.0070	0.65	0.14	81
TN	na	0.16	0.059	0.28	0.093	4
VA	na	0.15	0.020	0.31	0.13	6
WV	na	0.15	0.0070	0.81	0.18	23
KY	Bell	0.23	0.10	0.38	0.12	5
KY	Breathitt	0.25	0.050	0.43	0.19	3
KY	Clay	0.28	0.080	0.65	0.19	11
KY	Floyd	0.22	0.070	0.44	0.11	10
KY	Harlan	0.11	0.070	0.14	0.032	4
KY	Jackson	0.26	0.10	0.42	0.23	2
KY	Knott	nd	0.25	0.25	nd	1
KY	Knox	0.087	0.024	0.24	0.074	8
KY	Laurel	0.23	0.020	0.40	0.15	5
KY	Letcher	nd	0.44	0.44	nd	1
KY	Morgan	0.17	0.10	0.23	0.092	2
KY	Owsley	0.11	0.0070	0.17	0.089	3
KY	Perry	0.21	0.20	0.22	0.014	2
KY	Pike	0.088	0.016	0.25	0.067	18
KY	Whitley	0.051	0.012	0.090	0.033	4
KY	Wolfe	0.055	0.050	0.060	0.0071	2
TN	Anderson	0.095	0.059	0.13	0.050	2
TN	Campbell	0.23	0.18	0.28	0.071	2
VA	Lee	0.22	0.035	0.31	0.16	3
VA	Wise	0.093	0.020	0.15	0.067	3
WV	Boone	0.19	0.034	0.32	0.14	3
WV	Fayette	0.11	0.047	0.18	0.094	2
WV	Kanawha	0.070	0.045	0.095	0.022	4
WV	Logan	0.55	0.28	0.81	0.37	2
WV	Mingo	0.11	0.0070	0.38	0.13	10
WV	Raleigh	0.077	0.014	0.14	0.089	2