Regional Subsurface Geologic Cross Sections of the Mississippian System, Appalachian Basin, Eastern Kentucky

David C. Harris and Thomas N. Sparks
Regional Subsurface Geologic Cross Sections of the Mississippian System, Appalachian Basin, Eastern Kentucky

David C. Harris and Thomas N. Sparks
UNIVERSITY OF KENTUCKY
Charles T. Wethington Jr., President
Fitzgerald Bramwell, Vice President for Research and Graduate Studies
Jack Supplee, Director, Administrative Affairs, Research and Graduate Studies

KENTUCKY GEOLOGICAL SURVEY ADVISORY BOARD
Henry M. Morgan, Chair, Utica
Ron D. Gilkerson, Vice Chair, Lexington
William W. Bowdy, Fort Thomas
Steven Cawood, Frankfort
Hugh B. Gabbard, Winchester
Kenneth Gibson, Madisonville
Mark E. Gormley, Versailles
Roxanne Kruich, Louisville
William A. Mossbarger, Lexington
Jacqueline Swigart, Louisville
John F. Tate, Bonnyman
David A. Zegeer, Lexington
Ralph N. Thomas, Emeritus Member, Owensboro
George H. Warren Jr., Emeritus Member, Owensboro

KENTUCKY GEOLOGICAL SURVEY
James C. Cobb, State Geologist and Director
John D. Kiefer, Assistant State Geologist
Donald C. Haney, State Geologist Emeritus

Administrative Section:
Jackie Silvers, Head
Amanda Long, Staff Support Associate II
Jennifer Talley, Staff Support Associate I
Juanita G. Smith, Office Assistant, Henderson office

Geoscience Information Section:
Steven Cordiviani, Head
Donald R. Chesnut Jr., Geologist V
Carol L. Rathven, Manager, Communications and Technology Transfer
Bart Davidson, Manager, Office of Geologic Information
Margaret Luther Smith, Editor

Douglas W. Reynolds Jr., Geologist II, Communications Coordinator for the Kentucky Board of Registration for Professional Geologists
Richard A. Smith, Geologist II, Earth Science Information Center Coordinator
Joseph B. Dixon, Information Technology Manager I
James M. McElhone, Information Systems Technical Support Specialist I
Terry D. Hounshell, Chief Cartographic Illustrator
Michael L. Murphy, Graphic Design Technician
Collie Rulo, Graphic Design Technician
Luanne Davis, Staff Support Associate II

Theola L. Evans, Staff Support Associate I
William A. Briscoe III, Publication Sales Supervisor
Roger S. Banks, Account Clerk I
Mitzi McKinney, Stores Assistant

Energy and Minerals Section:
James A. Dranovzal, Head
Garland R. Dever Jr., Geologist V
Cortland F. Eble, Geologist V
Stephen F. Greb, Geologist V

David A. Williams, Geologist V, Manager, Henderson office
David C. Harris, Geologist IV
Brandon C. Nuttal, Geologist IV
William M. Andrews Jr., Geologist II
John B. Hickman, Geologist II
Anna E. Watson, Geologist I

Martin C. Noger, Geologist Emeritus

Geospatial Analysis Section:
Gerald A. Weisenfluh, Head
Daniel I. Carey, Hydrogeologist V
Warren H. Anderson, Geologist IV
Richard E. Sergeant, Geologist IV

Thomas N. Sparks, Geologist III
Douglas C. Curl, Geologist II

Steven L. Martin, Geologist II
Ernest E. Thacker, Geologist I
Mark F. Thompson, Geologist I

Michael P. Solis, Geological Technician

Water Resources Section:
James S. Dinger, Head
R. Stephen Fisher, Hydrogeologist V
James C. Currens, Hydrogeologist IV
Alex W. Fogle, Hydrogeologist III

Robert E. Andrews, Hydrogeologist II
E. Glynn Beck, Hydrogeologist II, Henderson office

Dennis H. Cumbie, Hydrogeologist II
Carlos M. Galceran Jr., Hydrogeologist II
C. Douglas R. Graham, Hydrogeologist II

Randall L. Paylor, Hydrogeologist II
Ron Counts, Geological Technician, Henderson office
Leslie K. Russo, Geological Technician
Gregory L. Secrist, Geological Technician

Geologic Hazards Section:
Edward W. Woolery, Geologist IV

Laboratory Services:
Henry E. Francis, Scientist II
Karen Cisler, Scientist I
Jason S. Backus, Research Analyst
Steven R. Mock, Research Analyst

Tracy Sizemore, Research Analyst

Well Sample and Core Library:
Patrick J. Gooding, Manager
Robert R. Daniel, Senior Laboratory Technician
CONTENTS

Introduction 1
Stratigraphy 1
Methodology 1
Big Lime Correlations 2
References Cited 3
Appendix A 5

FIGURE

1. Locations of the 14 cross sections 2
MISSION STATEMENT

The Kentucky Geological Survey at the University of Kentucky is a State-mandated organization whose mission is the collection, preservation, and dissemination of information about mineral and water resources and the geology of the Commonwealth. KGS has conducted research on the geology and mineral resources of Kentucky for more than 150 years, and has developed extensive public databases for oil and natural gas, coal, water, and industrial minerals that are used by thousands of citizens each year. The Survey’s efforts have resulted in topographic and geologic map coverage for Kentucky that has not been matched by any other state in the Nation.

One of the major goals of the Kentucky Geological Survey is to make the results of basic and applied research easily accessible to the public. This is accomplished through the publication of both technical and nontechnical reports and maps, as well as providing information through open-file reports and public databases.

Earth Resources—Our Common Wealth

Acknowledgments

We would like to thank TerraSciences, Inc., for providing the TerraStation II software used in this project to construct the cross sections. This publication benefited from reviews by Garland Dever, Steve Greb, and Warren Anderson. We would also like to acknowledge the dedicated efforts of Chris Martin, who digitized the well logs used in the study.

© 2000
University of Kentucky
For further information contact:
Manager, Communications and Technology Transfer
Kentucky Geological Survey
228 Mining and Mineral Resources Building
University of Kentucky
Lexington, KY 40506-0107

ISSN 1522-0834
Regional Subsurface Geologic Cross Sections of the Mississippian System, Appalachian Basin, Eastern Kentucky

David C. Harris and Thomas N. Sparks

INTRODUCTION

This series of 14 regional cross sections illustrates subsurface stratigraphic correlations of Mississippian (upper Carboniferous) rocks in the Appalachian Basin of eastern Kentucky. These cross sections were constructed as part of a regional stratigraphic study of the Mississippian “Big Lime,” a major oil- and gas-producing formation. The series illustrates 10 dip-oriented and 4 strike-oriented lines, extending from the Slade Formation outcrop belt on the northwest, to the state borders on the east and south. Stratigraphic and structural versions are shown for each section to better illustrate thickness and structural variations. These cross sections served as the regional framework during collection of stratigraphic data for the Big Lime project. Stratigraphic tops were collected for almost 8,000 wells in eastern Kentucky, from the top of the Mississippian to the Devonian black shale. Tops data shown in the cross sections are available in digital form from the Kentucky Geological Survey (Open-File Report OF-97-03).

STRATIGRAPHY

The Mississippian Big Lime (drillers’ term) is a major hydrocarbon reservoir in the Appalachian Basin of Kentucky. The Big Lime is stratigraphically equivalent to the lower Newman Limestone of Kentucky, the Greenbriar Limestone of West Virginia, and partly equivalent to the Ste. Genevieve Limestone of the Eastern Interior (Illinois) Basin. The Big Lime is middle to Late Mississippian (Meramecian to Chesterian) in age (Ettensohn, 1980). It was deposited in the Appalachian foreland basin within a broad embayment covering much of present-day West Virginia, eastern Kentucky, western Virginia, and eastern Tennessee (Youse, 1964). In most of the study area the Big Lime unconformably overlies siltstones and sandstones of the Borden Formation, an Osagean deltaic sequence (Youse, 1964; Birch, 1980; Frankie, 1990). In the southwestern part of the study area, the Big Lime overlies the Fort Payne Formation, a deeper-water marine carbonate unit above the Borden.

The Big Lime generally thickens toward the center of the Appalachian Basin to the southeast, ranging in thickness from zero in the outcrop belt along the Cincinnati Arch to more than 450 ft in southeasternmost Kentucky. Regional structural dip is to the southeast, toward the central Appalachian Basin (MacQuown and Pear, 1983).

Hydrocarbon reservoirs in the Big Lime of Kentucky occur in two general lithofacies: oolitic lime grainstones and dolomitic limestones to dolostones (Webb, 1972; Birch, 1983; MacQuown and Pear, 1983; Nicholson, 1983; Frankie, 1990; Smosna, 1996). Dolostone reservoirs are primarily restricted to the basal Big Lime, and occur in broad, discontinuous, linear zones that overlie thin areas in the underlying Borden clastics. This basal zone may represent filling of channels cut into the Borden before the Big Lime was deposited, filling of relict depositional topography on the top of the Borden, or syndepositional faulting (Tebo and others, 1994). Oolitic reservoirs can occur anywhere within the interval and were deposited in shoals or tidal channels (MacQuown and Pear, 1983).

METHODOLOGY

These cross sections were generated by computer using 155 digitized geophysical logs. Wells included in the sections were chosen on the basis of location, presence of Big Lime hydrocarbon production, depth of penetration, and log availability. All wells extend to the top of the Devonian Ohio (Chattanooga) Shale, and typically have gamma-ray and formation-density logs available. We tried to include wells in major Big Lime oil or gas fields where possible. A complete list of wells used in the cross sections, sorted by county, is included in Appendix A.

Well logs are plotted at a vertical scale of 1 in. equals 400 ft for structural sections and 1 in. equals 200 ft for stratigraphic sections. Logs are spaced proportionately between edges at a horizontal scale of 1 in. equals 8 mi. This scaling results in a vertical exaggeration of 422:1 for the structural sections and 211:1 for the stratigraphic sections. Stratigraphic correlations are illus-
trated using lithologic patterns, which are explained in the “Key to Horizons” included on each section. A location map is provided on each section, and the location of the current line is highlighted in green. Figure 1 shows the locations of all the sections.

Each stratigraphic section uses the top of the Big Lime as a datum. Logs were aligned on this horizon to discount post-depositional structural movement, permitting easier interpretation of stratigraphic variations. Each structural section uses a sea-level datum, and logs are adjusted to their present-day structural positions. This allows interpretation of the regional structure of these rocks. The approximate locations of mapped surface faults are indicated along the bottom of the structural sections. There may be other unmapped surface faults or subsurface faulting between the wells on these sections, particularly in areas with steep dip between wells. Data were not available on the location or throw of subsurface faults in the study area. Major structural features are also labeled on the structural sections.

**Big Lime Correlations**

Much of the hydrocarbon production from the Big Lime interval is stratigraphically controlled. Because of this, the internal stratigraphy and facies relationships in the Big Lime are key factors in exploration. We attempted to correlate subzones within the Big Lime interval where possible. Previous workers (Birch, 1980; Pear, 1980; Hetherington, 1981) correlated subzones within the Big Lime in much smaller areas. We attempted to extend their work to the down dip areas in eastern Kentucky. Four subzones were defined within the Big Lime on the basis of persistent, thin, shale marker beds (high gamma-ray markers), and correlated within the sections. In updip areas (to the northwest), the Big Lime section becomes thinner and has a more massive gamma-ray signature. As a result, subzone correlations could not be extended into updip areas with confidence, and they are not carried completely across the dip sections. In general, we found the subzone correlations to be difficult to make, and of questionable validity in some areas. They should be used as a general guide, and refined by additional correlation in areas of specific interest. The subzone log response was not calibrated by description of cuttings or core. Gamma-ray correlations within the Big Lime are complicated by the presence of radioactive carbonates, which produce high gamma-ray signatures, similar to a shale response. The radioactive mineral is not known, but the gamma-ray response appears to be caused by uranium, as indicated on the few spectral gamma-ray logs available. We avoided picking radioactive carbonates as zone boundaries, but caution should be used in extending this work into other areas.

The subzone correlations may relate to sequence stratigraphic interpretations made by Al-Tawil (1994a, b, 1998) for the Mississippian interval in the Appalachian Basin, but the exact relationship has not been determined. Al-Tawil integrated outcrop interpretations with subsurface well log data, but did not have access to the data from this study.

These cross sections illustrate the regional southeastern dip of Mississippian rocks into the Appalachian Basin. Major structures shown on the sections include the Paint Creek Uplift, the Rockcastle River Uplift, and the Pine Mountain thrust sheet. The Big Lime reaches a maximum thickness of 427 ft in Pike County, and 482 ft on the thrust sheet in Bell County, southeast of the Pine Mountain Fault. Thickness variations of individual subzones within the Big Lime have not been studied in detail. In some areas, the Big Lime shows reciprocal thickness relationships with the underlying Borden Group, thickening over Borden thins. This is thought to have been caused by the filling of erosional topography on the Borden surface (McQuown and Pear, 1983; Conrad and others, 1994; Moshier and Stamper, 1994; Tebo and others, 1994).
REFERENCES CITED


Hudnall, J.S., and Browning, I.B., 1949, Structural geologic map of the Paint Creek Uplift in Floyd, Johnson, Magoffin, Morgan, Lawrence, and Elliott Counties: Kentucky Geological Survey, ser. 9, scale 1 in. = 1 mi.


Nicholson, T.J., 1983, Geology and the accumulation of hydrocarbons in the “Big Lime” and Borden Group (Mississippian) and pre-Chariton group (Silurian-Devonian) of Knox, Laurel, and Whitley Counties, Kentucky: Lexington, University of Kentucky, master’s thesis, 188 p.


## Appendix A. County Listing of Wells Used in Regional Cross Sections

<table>
<thead>
<tr>
<th>APNO</th>
<th>OPERATOR</th>
<th>NUMBER</th>
<th>FARM NAME</th>
<th>CARTER COORDINATES</th>
<th>TOTAL DEPTH</th>
<th>ELEV</th>
<th>RESULT</th>
<th>DATE</th>
<th>QUANT</th>
<th>UNIT</th>
<th>PAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1601137951</td>
<td>THE WISER OIL</td>
<td>7</td>
<td>TRACHER COAL,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1601334477</td>
<td>WEAVER OIL &amp; GAS</td>
<td>1</td>
<td>J M HUBER CORP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1601509547</td>
<td>WEAVER OIL &amp; GAS</td>
<td>1</td>
<td>GABBA ROY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1601383638</td>
<td>THE WISER OIL</td>
<td>2</td>
<td>BIG JM COAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1601339222</td>
<td>ARCO EXPL OR DIV</td>
<td>1</td>
<td>BROOKE ROY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**COUNTY = BELL**

**TOTAL NUMBER OF WELLS LISTED IN BELL COUNTY = 5**

<table>
<thead>
<tr>
<th>APNO</th>
<th>EQUITABLE RESO</th>
<th>NUMBER</th>
<th>FARM NAME</th>
<th>CARTER COORDINATES</th>
<th>TOTAL DEPTH</th>
<th>ELEV</th>
<th>RESULT</th>
<th>DATE</th>
<th>QUANT</th>
<th>UNIT</th>
<th>PAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1602570818</td>
<td>EQUITABLE RESO</td>
<td>1</td>
<td>YEAGER</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1602545047</td>
<td>PANSWRL PRODUC</td>
<td>GA1</td>
<td>J.C. MORT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1602536655</td>
<td>JUICE, PAUL</td>
<td>147A</td>
<td>KENTUCKY WEST</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1602548752</td>
<td>PANSWRL PRODUC</td>
<td>1</td>
<td>BREWER, SHELTON</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1602534035</td>
<td>CUMBERLAND HAR</td>
<td>1</td>
<td>CUMBERLAND HAR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1602532549</td>
<td>CUMBERLAND HAR</td>
<td>1</td>
<td>CUMBERLAND HAR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**COUNTY = BREATHITT**

**TOTAL NUMBER OF WELLS LISTED IN BREATHITT COUNTY = 3**

<table>
<thead>
<tr>
<th>APNO</th>
<th>PENN VIRGINIA</th>
<th>NUMBER</th>
<th>FARM NAME</th>
<th>CARTER COORDINATES</th>
<th>TOTAL DEPTH</th>
<th>ELEV</th>
<th>RESULT</th>
<th>DATE</th>
<th>QUANT</th>
<th>UNIT</th>
<th>PAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1604597111</td>
<td>SUEL CRABO</td>
<td>1</td>
<td>LOWE, EVELYN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1604597404</td>
<td>IRONCROSS, IN</td>
<td>1</td>
<td>IRONCROSS, IN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1604533661</td>
<td>INLAND GAS CO</td>
<td>580</td>
<td>HOPKIN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**COUNTY = CARTER**

**TOTAL NUMBER OF WELLS LISTED IN CARTER COUNTY = 4**

<table>
<thead>
<tr>
<th>APNO</th>
<th>PENN VIRGINIA</th>
<th>NUMBER</th>
<th>FARM NAME</th>
<th>CARTER COORDINATES</th>
<th>TOTAL DEPTH</th>
<th>ELEV</th>
<th>RESULT</th>
<th>DATE</th>
<th>QUANT</th>
<th>UNIT</th>
<th>PAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1605150713</td>
<td>PENN VIRGINIA</td>
<td>1003</td>
<td>FORDSON</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1605169931</td>
<td>RAMCO OIL &amp; GA</td>
<td>1</td>
<td>WHITE, JAMES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1605170445</td>
<td>RAMCO OIL &amp; GA</td>
<td>1</td>
<td>BARNARD, WILL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1605152053</td>
<td>RAMCO OIL &amp; GA</td>
<td>1</td>
<td>BOWLING, NANCY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1605174579</td>
<td>KENNO GAS, IN</td>
<td>1</td>
<td>FIELD, BOY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1605154583</td>
<td>KENNO GAS, IN</td>
<td>1</td>
<td>KENNO GAS, IN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1605167009</td>
<td>APPALACHIAN OR</td>
<td>1</td>
<td>SAWERS, RUBEN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1605179453</td>
<td>HUNTINGTON ENE</td>
<td>6</td>
<td>FLINN, HERA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**COUNTY = CLAY**

**TOTAL NUMBER OF WELLS LISTED IN CLAY COUNTY = 9**

<table>
<thead>
<tr>
<th>APNO</th>
<th>TERRA OIL &amp; GAS</th>
<th>NUMBER</th>
<th>FARM NAME</th>
<th>CARTER COORDINATES</th>
<th>TOTAL DEPTH</th>
<th>ELEV</th>
<th>RESULT</th>
<th>DATE</th>
<th>QUANT</th>
<th>UNIT</th>
<th>PAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1606339081</td>
<td>TERRA OIL &amp; GAS</td>
<td>1</td>
<td>BURKE, EVERETT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1606339048</td>
<td>ELLENTIA COUNTY</td>
<td>1</td>
<td>BROWN, OPAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1606323542</td>
<td>MONITOR PETROLE</td>
<td>1</td>
<td>ISON, CEIL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**COUNTY = ELLIOTT**

**TOTAL NUMBER OF WELLS LISTED IN ELLIOTT COUNTY = 3**

<table>
<thead>
<tr>
<th>APNO</th>
<th>KEPCO, INC</th>
<th>NUMBER</th>
<th>FARM NAME</th>
<th>CARTER COORDINATES</th>
<th>TOTAL DEPTH</th>
<th>ELEV</th>
<th>RESULT</th>
<th>DATE</th>
<th>QUANT</th>
<th>UNIT</th>
<th>PAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1607141800</td>
<td>KEPCO, INC</td>
<td>KL315</td>
<td>MARTIN, HELEN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1607177727</td>
<td>EASTERN KENTUC</td>
<td>KF099</td>
<td>E. P. C. ORCH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1607177070</td>
<td>EASTERN KENTUC</td>
<td>KL886</td>
<td>E. P. C. ORCH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1607176609</td>
<td>EASTERN KENTUC</td>
<td>KF930</td>
<td>E. P. C.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1607131197</td>
<td>SOUTHEASTERN</td>
<td>D91</td>
<td>HATCHER, JAMES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1607179685</td>
<td>C &amp; D &amp; ENT-GA</td>
<td>CB1</td>
<td>LAFAYETT, SAMM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**COUNTY = FLOYD**

**TOTAL NUMBER OF WELLS LISTED IN FLOYD COUNTY = 6**

<table>
<thead>
<tr>
<th>APNO</th>
<th>CUMBERLAND HAR</th>
<th>NUMBER</th>
<th>FARM NAME</th>
<th>CARTER COORDINATES</th>
<th>TOTAL DEPTH</th>
<th>ELEV</th>
<th>RESULT</th>
<th>DATE</th>
<th>QUANT</th>
<th>UNIT</th>
<th>PAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1609577722</td>
<td>CUMBERLAND HAR</td>
<td>1</td>
<td>CUMBERLAND HAR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1609560442</td>
<td>PENN VIRGINIA</td>
<td>8832</td>
<td>BLANTON, BALE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1609579590</td>
<td>CUMBERLAND HAR</td>
<td>1</td>
<td>CUMBERLAND HAR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1609581310</td>
<td>ARK LAND CO</td>
<td>E3</td>
<td>ARK LAND CO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1609577355</td>
<td>THE WISER OIL</td>
<td>1</td>
<td>BANK OF HIRWAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1609529737</td>
<td>RAY RESOURCES, INC</td>
<td>153</td>
<td>GORDON PASS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1609581044</td>
<td>ARK LAND CO</td>
<td>E1</td>
<td>ARK LAND CO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1609572463</td>
<td>A N R PRODUC</td>
<td>KY1</td>
<td>PENN VIRGINIA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**COUNTY = HARRLAN**

**TOTAL NUMBER OF WELLS LISTED IN HARRLAN COUNTY = 6**
### Appendix A

<table>
<thead>
<tr>
<th>APNO</th>
<th>OPERATOR</th>
<th>WELL NUMBER</th>
<th>FARM NAME</th>
<th>CO</th>
<th>CARTER COORDINATES</th>
<th>DEPTH</th>
<th>RESULT</th>
<th>DATE</th>
<th>QUANTITY</th>
<th>UNIT</th>
<th>PAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>161894662</td>
<td>MIDAMCO, INC</td>
<td>1</td>
<td>MCKWORTHIER, DEW</td>
<td>OSL</td>
<td>1375FLN0152FL04</td>
<td>K9</td>
<td>01002 03754</td>
<td>364KNOX</td>
<td>703093</td>
<td>0010</td>
<td>MCFGPD</td>
</tr>
<tr>
<td>1618946554</td>
<td>OHIO-KENTUCKY</td>
<td>1</td>
<td>HUDSON, EMEN</td>
<td>OSL</td>
<td>1300FLN0152FL04</td>
<td>K9</td>
<td>01096 01660</td>
<td>344CORN</td>
<td>12605</td>
<td>1618946523</td>
<td>OHIO-KENTUCKY</td>
</tr>
</tbody>
</table>

#### COUNTY = OWSELEY

- Number of wells listed in Owseley County = 3

#### COUNTY = PERRY

- Number of wells listed in Perry County = 5

#### COUNTY = PIKE

- Number of wells listed in Pike County = 21

#### COUNTY = POWELL

- Number of wells listed in Powell County = 1

#### COUNTY = PULASKI

- Number of wells listed in Pulaski County = 3

#### COUNTY = ROWAN

- Number of wells listed in Rowan County = 1

#### COUNTY = WAYNE

- Number of wells listed in Wayne County = 2

#### COUNTY = WHITLEY

- Number of wells listed in Whitley County = 7

---

**TOTAL NUMBER OF WELLS LISTED IN PIKE COUNTY = 21**

**TOTAL NUMBER OF WELLS LISTED IN POWELL COUNTY = 1**

**TOTAL NUMBER OF WELLS LISTED IN PULASKI COUNTY = 3**

**TOTAL NUMBER OF WELLS LISTED IN ROWAN COUNTY = 1**

**TOTAL NUMBER OF WELLS LISTED IN WAYNE COUNTY = 2**

**TOTAL NUMBER OF WELLS LISTED IN WHITLEY COUNTY = 7**
<table>
<thead>
<tr>
<th>APINO</th>
<th>OPERATOR</th>
<th>WELL NUMBER</th>
<th>FARM NAME</th>
<th>CARTER COORDINATES</th>
<th>ELEV</th>
<th>TOTAL DEPTH</th>
<th>TD FM</th>
<th>RESULT</th>
<th>DATE</th>
<th>QUANT</th>
<th>UNIT</th>
<th>PAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1623730520</td>
<td>EXXON CORP</td>
<td>1</td>
<td>BANKS, ORVILLE</td>
<td>WLF 3100 FSL 0350 FEL 313 074</td>
<td>04028</td>
<td>12288</td>
<td>400PCMB</td>
<td>D&amp;A</td>
<td>7/15/76</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16237350169</td>
<td>REAPLORE, INC</td>
<td>1</td>
<td>BURTON, JACK &amp;</td>
<td>WLF 2844 FSL 1894 FEL 22 P73</td>
<td>04063</td>
<td>01809</td>
<td>357RHLL</td>
<td>D&amp;A</td>
<td>1/25/82</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**COUNTY = WOLFE**

Number of wells listed in Wolfe County = 2

Total wells listed = 155