CHARACTERIZATION OF CENTRAL APPALACHIAN BASIN CBM DEVELOPMENT: POTENTIAL FOR CARBON SEQUESTRATION AND ENHANCED CBM RECOVERY

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ABSTRACT

In May 2004, the Department of Energy (*DOE*) commissioned the Virginia Center for Coal and Energy Research (*VCCER*) at Virginia Tech and Marshall Miller & Associates, Inc. (*MM&A*) to conduct an assessment of the carbon sequestration potential of the Pennsylvanian-age coalbeds in the Central Appalachian Basin. Preliminary conclusions of this work indicate that coals in this region do have significant sequestration potential, particularly in Buchanan, Dickenson and Wise Counties. The total carbon dioxide storage capacity of the unmineable Lee and Pocahontas Formation coals in southwestern Virginia is estimated at 7.33 trillion cubic feet (*Tcf*). The technically feasible storage capacity of the region, including only those areas currently developed for coalbed methane (*CBM*), is estimated at 4.94 Tcf. Enhanced coalbed methane recovery that theoretically may result from implementing a large-scale carbon dioxide injection program is estimated at 0.9 Tcf.

Evaluated coals include those comprising the Pocahontas Formation and the overlying Lee Formation (New River Formation in West Virginia). The Lee and Pocahontas Formation coals will likely provide favorable reservoirs for carbon sequestration due to their thickness, depth, rank, and permeability characteristics. *Figure 1* is a regional coal rank map for the Central Appalachian Basin based on the percentage of volatile matter. The coal ranks grade from high-volatile A bituminous (lower rank) in the northwest and west to a small area of semi-anthracite (higher rank) occurring in McDowell and Wyoming Counties, West Virginia.

The gassiest CBM areas (400 to 600 cubic feet per ton) in the Central Appalachian Basin occur generally within the low-volatile, high-rank coal areas, including the Oakwood CBM Field located in Buchanan County, Virginia (*Figure 2*). Areas of intermediate gas content (200 to 400 cubic feet per ton) are found mostly in the medium-volatile, mid-rank coal areas. The lowest gas contents (less than 200 cubic feet per ton) are located generally within high-volatile, low-rank regions. Higher rank areas with associated high gas content should provide the optimum reservoirs for carbon sequestration since these coals will likely have greater storage capacity for carbon dioxide.

In order to help quantify the carbon sequestration potential occurring in portions of southwestern Virginia, a net coal isopach map for the Middle to Lower Lee and Pocahontas Formations was developed (*Figure 3)*. Net coal thickness for this stratigraphic sequence ranges from 5.8 to 47.2 feet and averages 18.6 feet across the study area. Using this map, a volumetric approach was applied to determine the carbon dioxide storage capacity of the deep coal seams in Buchanan and Dickenson Counties, Virginia. Areas affected by underground mining in the Pocahontas No. 3 seam and a surrounding 0.5-mile wide buffer zone were not included in determining the total storage capacity of 7.33 Tcf within the study area, due to potential leakage of injected CO_2 from subsidence in the overlying strata. The economically feasible storage capacity estimate

of 4.94 Tcf was determined by only including those areas where CBM production has previously been developed.

The enhanced coalbed methane (*ECBM*) recovery potential of the deep, unmineable coal seams in Buchanan and Dickenson Counties, Virginia was estimated using a similar methodology to that described above. This estimate includes the gas not likely to be economically recovered by primary production operations or that is expected to remain as residual gas, and is therefore potentially recoverable by carbon-dioxide enhanced recovery operations. The economically feasible ECBM potential of nearly 0.9 Tcf was determined by including only the areas where CBM production has previously been developed and excluding areas affected by underground mining in the Pocahontas No. 3 seam.

The preliminary conclusions of this work indicate that coalbeds in southwest Virginia have significant potential for carbon sequestration, particularly in Buchanan, Dickenson and Wise Counties. Regional mapping indicates that carbon sequestration potential may also exist in adjoining counties in southern West Virginia.

Figure 1: Regional Coal Rank, Central Appalachian Basin

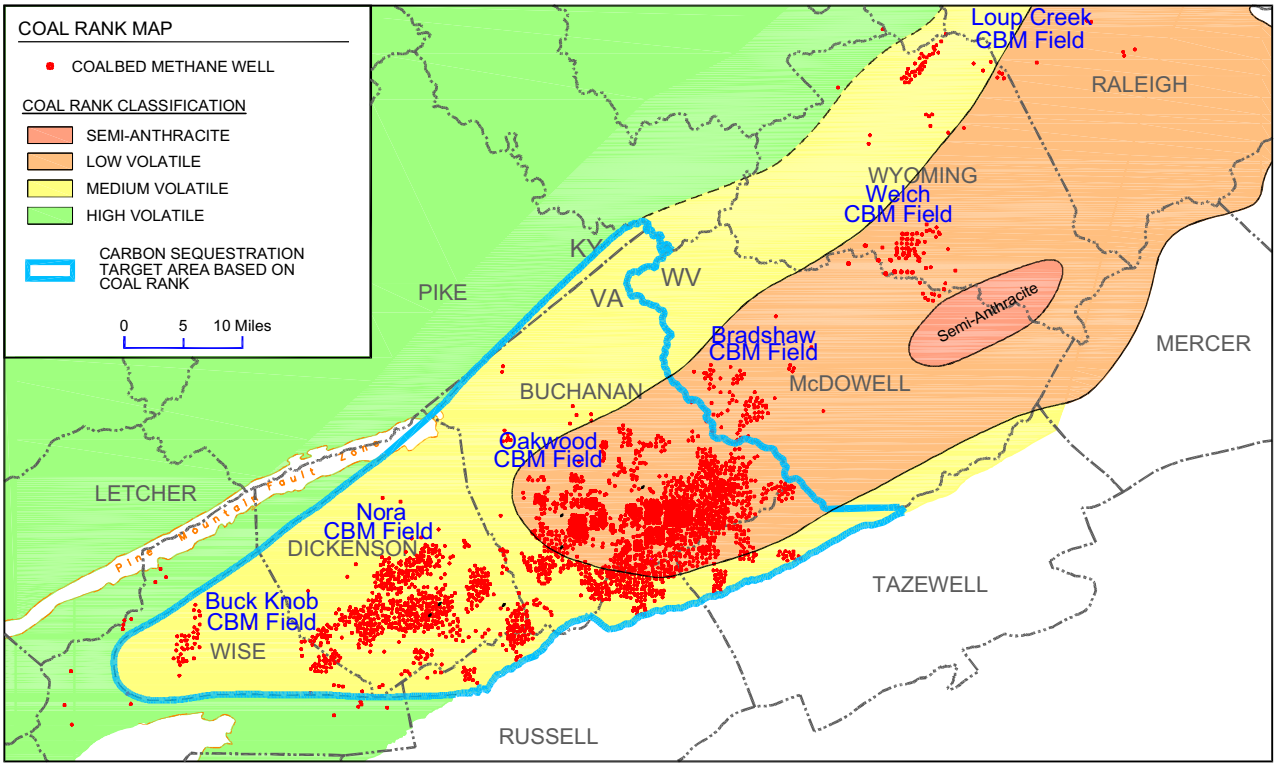

Figure 2: Regional Gas Content, Central Appalachian Basin

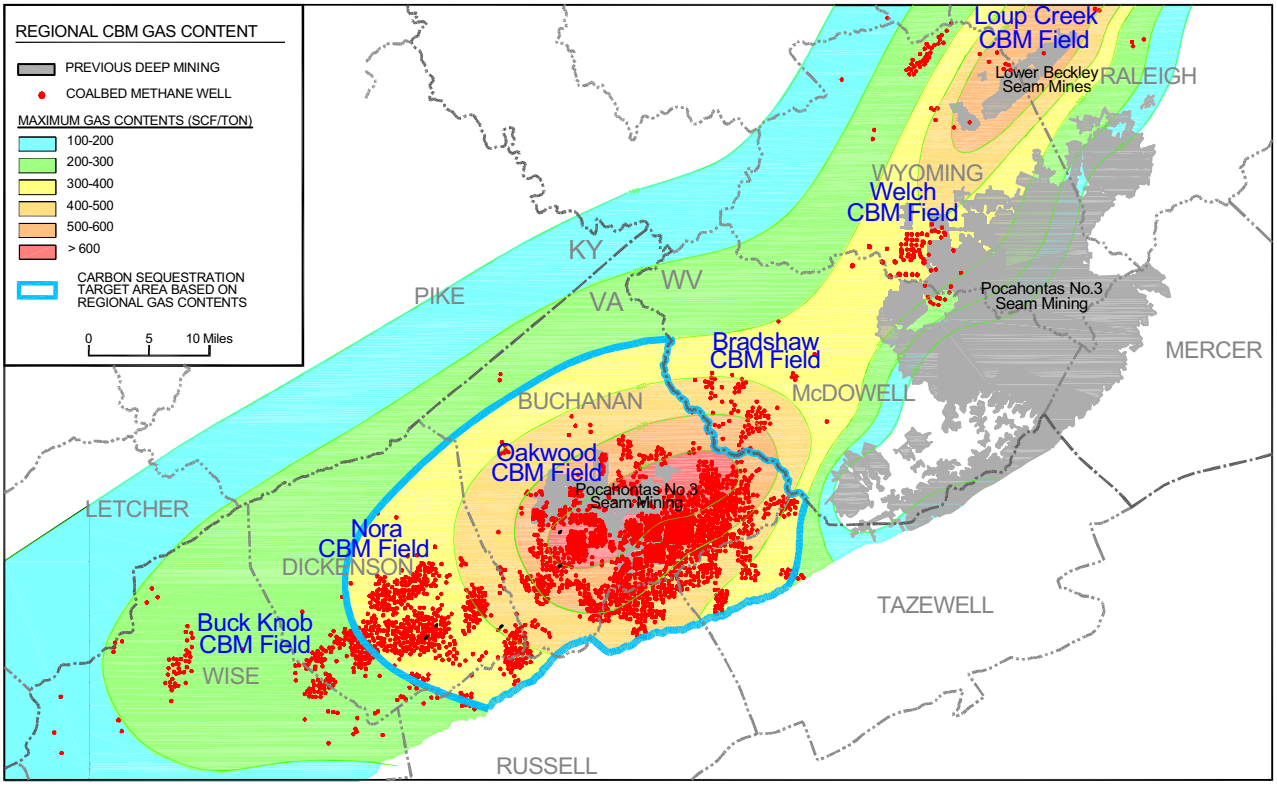

Figure 3: Net Coal Isopach, Lee and Pocahontas Formations