COMPUTERIZED CALCULATION OF LIGNITE RESOURCES IN TEXAS

A Progress Report

by

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LIGNITE RESOURCES IN TEXAS

INTRODUCTION

The Bureau of Economic Geology (BEG) is currently using the National Coal Resources Data System (NCRDS) to calculate near-surface lignite resources in the state of Texas. Data available to the BEG for this project consist largely of geophysical logs of holes drilled for lignite exploration. The logs were supplied by industry on a proprietary basis and generally have density and resistivity traces; occasionally natural gamma is also available. The holes average 150-200 ft in depth; some are as deep as 300 ft.

The distribution of the data precludes accurate correlation of individual lignite seams. Therefore resources are calculated using a summation of seams in the borehole (total lignite). There is no standard NCRDS method of data selection for calculation of total coal resources; the following method used by the BEG has evolved from a series of trial methods.

PACER is used to search TXSTRAT for all information located within a specified topographic quadrangle and a surrounding three-mile border. The three-mile border is added so that resource calculation includes inferred resources from points located outside the quadrangle latitudinal and longitudinal limits. All non-lignite (rock) lithologies in this first file are then searched and set to zero thickness, creating a file containing all data point locations with zero total thickness. The first file is searched again for lignite lithologies in the three thickness categories specified by the USGS and two thickness categories used in the state of Texas (2 to 3 ft, and greater or equal to 3 ft). All five lignite files are then merged one at a time with the zero-thickness file. The thicknesses are then summed in each borehole for all five files. Data locations (boreholes) that contain no coal or seams thinner or thicker than the thickness category searched thus have zero total thickness. Control from these points results in improved interpolation of thicknesses between points. Subsequent resource estimates may be conservative, but the method prevents unrealistically large tonnages in the inferred resource category, which was the major problem in earlier methods.

Lignites in Texas occur in three Eocene stratigraphic units: The Wilcox Group, the Jackson Group, and the Yegua Formation (Claiborne Group). Because individual data locations are confidential, NCRDS resource estimates are not presented by quadrangle, but by geographic regions defined by Kaiser and others (1980) (figure 1). The Wilcox Group is divided into four regions: east-central, northeast, Sabine Uplift, and south. The Jackson is divided into east and south regions; the Yegua is combined with the Jackson in the east. Resource maps are created for each region by combining NCRDS-produced maps of adjoining topographic quadrangles. Only the outer limit of the inferred resource circles are shown in order to protect the confidential locations of the point-source information.

Data for the Wilcox Group in east-central, northeast, and Sabine Uplift regions have been entered into the NCRDS, but resource calculations are complete only for the east-central and northeast regions. The maps and resource estimates of these two regions are discussed in detail.

WILCOX GROUP, EAST-CENTRAL TEXAS

The east-central Texas region is defined as the outcrop area lying between the Colorado and Trinity Rivers. In this region, the Wilcox Group is divided into three formations. From oldest to youngest these are: the Hooper, the Simsboro, and the Calvert Bluff. The southeasterly dip of these units decreases from south to north through the region (from 1 or 2 degrees to .5 degree).

The Calvert Bluff and the Hooper Formations are the major lignite-bearing units (fig. 5). The Simsboro is a major sand unit, but contains a few lignites of limited continuity. The Calvert Bluff contains two persistent lignite zones, one just above the top of the Simsboro and the other just below the Carrizo Sand. The lower Calvert Bluff zone occurs throughout east-central Texas, the upper zone only in the northern third of the region. The lignites in the Hooper occur just below the Simsboro (fig. 2). Resources were calculated for the Wilcox Group

in entirety, because of the difficulty in dividing the short stratigraphic section represented by the geophysical log into formations.

Figure 3 shows the resources of seams between 2.5 to 5 ft thick in the east-central region. Several boundaries were used as limits to resource calculations. The Estimated Resource Limit is a line that approximates the edge of the Simsboro outcrop. This line limits the extent of the resource calculation where Simsboro sands are well-developed. It is no longer used to the north where the Simsboro sands thin, break-up, and Simsboro-equivalent sediments bear lignites. In Robertson, Leon, and Freestone Counties, the resource circles extend past the Wilcox/Carrizo contact, since there are lignites in the upper Calvert Bluff which are still considered near-surface. The Colorado and Trinity Rivers are both used as boundaries to limit resource calculations.

The mined-out areas, shown in black, represent the best approximation of current and past lignite mining. The numerous small areas in Bastrop County are from old underground mines. The Sandow surface mine south of Rockdale and the Big Brown surface mine near Fairfield are active.

Figures 4 and 5 show resources for the remaining USGS thickness categories. Resources cover progressively smaller acreages as seam thickness increases. Figures 6 and 7 are Wilcox resource maps for the two thickness categories that have been used in previous BEG resource estimates (Kaiser and others, 1980). The same boundaries and approach were used as for the USGS category maps. There are only minor differences in the appearance of figures 6 and 7, as opposed to the obvious decrease in acreage seen in figures 3 though 5.

Table 1 shows the measured, indicated, and inferred resources for all three USGS thickness categories of the Wilcox Group in east-central Texas. The tonnages shown have been rounded off to the nearest million tons, although only two to three digits are truly significant. The demonstrated resources (measured plus indicated) total 4,174 million short tons (3,795 million t) which is approximately 48 percent of the total resource figure (8,764 million short

tons or 7,967 million t). Table 2 shows the east-central Texas resources for the two Texas thickness categories. Demonstrated resources total 4,987 million short tons (4,534 million t), indicating a moderate increase (15 percent) in tonnage by including seams between 2 and 2.5 ft thick. The total resource estimate is 10,370 million short tons (9,427 million t) of which approximately 37 percent are demonstrated resources. The total resource figure in Table 2 can be directly compared to the estimate of Kaiser and others (1980). Their estimate for total resources for seams greater than 2 ft thick was 8,641 million short tons. The use of USGS thickness categories provided an estimate closer to, but still larger than, that of Kaiser and others (1980). This may be indicative of an even more conservative approach taken by Kaiser and indirect calculation of resources in seams 2-3 ft thick.

Table 1. Resource estimates in millions of short tons for the Wilcox Group, east-central Texas: USGS thickness categories.

Seam thickness	Measured	Indicated	Inferred	Total
2.5 - 5 ft	790	1,926	3,100	5,816
5 - 10 ft	346	737	1,276	2,359
> 10 ft	146	229	214	589
Total	1,282	2,892	4,590	8,764

Table 2. Resource estimates in millions of short tons for the Wilcox Group, east-central Texas: Texas thickness categories.

Seam thickness	Measured	Indicated	Inferred	Total	Total (Kaiser and others, 1980)
2 - 3 ft	351	1,024	1,859	3,234	2,160
≥ 3 ft	1,174	2,438	3,524	7,136	6,481
Total	1,525	3,462	5,383	10,370	8,641

WILCOX GROUP, NORTHEAST TEXAS

The Wilcox outcrop from the Trinity River northeastward to the Texas-Louisiana border defines the northeast region. The Simsboro sands in this region have broken up to the extent that the Simsboro is no longer defined as a formation and the Wilcox is no longer subdivided. Lignites occur throughout the stratigraphic section. Therefore, no stratigraphic lines limiting resource estimation were required other than the contact between the Midway and Wilcox Groups. Resource calculations were allowed to extend beyond the boundary depicting the contact of the Wilcox and younger sediments; dip is gentle in this region and lignites are still under less than 200 ft of cover.

Several mined-out areas are delineated for old mine workings in Hopkins and Henderson Counties on figures 8 through 12, but there are two active mine sites which are not shown. One mine is near Winfield in Titus County and the other is in Hopkins County at Thermo. These mines supply lignite to the Monticello steam electric station. An accurate representation of the areal extent of mining was not available at the time data maps were submitted to the USGS for digitization. To more accurately estimate remaining resources, the production figure plus loss in mining tonnage must be subtracted from the NCRDS-calculated estimates presented in Tables 3 and 4. Both the original NCRDS estimates and the adjusted resource totals are given.

Resources were not calculated under Lake Texarkana or Cedar Creek Reservoir. The proposed Marvin C. Nichols reservoir, which would be an extension of Lake Texarkana, was used as an optional boundary; resources were calculated with and without the proposed reservoir. Mining of these resources would likely occur before inundation of the reservoir, therefore estimates including tonnages under the proposed reservoir are appropriate.

The decrease in resource acreage as thickness categories increase is readily apparent in figures 8 through 10. Figures 9 and 10 clearly indicate that there are very few thick seams in this region.

Table 3 summarizes the resource estimates for the three USGS thickness categories in this region. Production from the two mines mentioned earlier has totaled 48,695,097 short tons (44,268,270 t) from 1978-1982. This production subtracted from the total resource estimate yields 8,496 million short tons (7,723 million t). Production tonnages should be increased by 20 percent to include loss in mining; this makes a total depletion of 58,434,116 short tons (53,121,923 t). Demonstrated resources in Table 3 (minus depletion) total 2,530 million short tons (2,300 million t) or about 30 percent of the total. The tonnage figure shown for the Marvin C. Nichols reservoir is a simple subtraction between the two estimates for all three categories.

The resources for the Texas thickness categories are summarized in Table 4. The estimate for this region by Kaiser and others (1980) is 8,359 million short tons (7,599 million t), substantially less (27 percent) than the adjusted estimate of approximately 11,519 million short tons (10,472 million t) shown in Table 4. The estimate using the USGS thickness categories is again closer to the estimate of Kaiser. The substantial difference in tonnages between the two NCRDS estimates (8,487 and 11,519 million short tons) arises from the large number of thin (2 to 2.5 ft) seams in the region.

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Table 3. Resource estimates in millions of short tons for the Wilcox Group, northeast Texas: USGS thickness categories.

Seam thickness	Measured	Indicated	Inferred	Total
2.5 - 5 ft excluding reservoir tonnage	458	1,471	4,246	6,175
2.5 - 5 ft including reservoir tonnage	461	1,487	4,332	6,280
>5 - 10 ft excluding reservoir tonnage	129	450	1,407	1,986
>5 - 10 ft including reservoir tonnage	130	454	1,413	1,996
>10 ft both cases	12	44	213	269
Original total excluding reservoir tonnage	599	1,965	5,866	8,430
Original total including reservoir tonnage	603	1,985	5,958	8,545
Marvin C. Nichols Reservoir (Proposed)	3	19	93	115
Adjusted total excluding reservoir tonnage				8,372
Adjusted total including reservoir tonnage				8,487

Table 4. Resource estimates in millions of short tons for the Wilcox Group, northeast Texas: Texas thickness categories.

Seam thickness	Measured	Indicated	Inferred	Total	Kaiser and others, 1980
2 - 3 ft excluding reservoir tonnage	247	864	3,134	4,245	3,260
2 - 3 ft including reservoir tonnage	247	875	3,243	4,365	
≥ 3 ft excluding reservoir tonnage	512	1,631	5,068	7,211	5,099
≥ 3 ft including reservoir tonnage	514	1,644	5,114	7,272	
Total excluding reservoir tonnage	759	2,495	8,202	11,456	8,359
Total including reservoir tonnage	761	2,520	8,357	11,637	
Marvin C. Nichols Reservoir	2	25	155	182	
Adjusted total excluding reservoir tonnage				11,337	
Adjusted total including reservoir tonnage				11,519	

REFERENCE

Kaiser, W. R., Ayers, W. B., and LaBrie, L. W., 1980, Lignite Resources in Texas: The University of Texas at Austin, Bureau of Economic Geology, Report of Investigations No. 104, 52 p.

FIGURE CAPTIONS

Figure 1. Location of geographic regions for outcrop belts of the Wilcox, Jackson, and Yegua units (modified from Kaiser and others, 1980).

Figure 2. Stratigraphic occurrence of lignite zones (hachured areas) in the Wilcox Group for two geographic regions.

Figure 3. Resource map for seams 2.5 to 5 ft thick, Wilcox Group, east-central Texas. Total resources are 5,816 million short tons (5,287 million t).

Figure 4. Resource map for seams greater than 5 to 10 ft thick, Wilcox Group, east-central Texas. Total resources are 2,359 million short tons (2,145 million t).

Figure 5. Resource map for seams greater than 10 ft thick, Wilcox Group, east-central Texas. Total resources are 589 million short tons (535 million t).

Figure 6. Resource map for seams 2 to 3 ft thick, Wilcox Group, east-central Texas. Total resources are 3,234 million short tons (2,940 million t).

Figure 7. Resource map for seams greater than or equal to 3 ft thick, Wilcox Group, east-central Texas. Total resources are 7,136 million short tons (6,487 million t).

Figure 8. Resource map for seams 2.5 to 5 ft thick, Wilcox Group, northeast Texas. Total resources are 6,175 (excluding reservoir tonnage) and 6,280 (including reservoir) million short tons (5,614 million t and 5,709 million t respectively).

Figure 9. Resource map for seams >5 to 10 ft thick, Wilcox Group, northeast Texas. Total resources are 1,986 (excluding reservoir tonnage) and 1,996 (including reservoir) million short tons (1,805 million t and 1,815 million t, respectively).

Figure 10. Resource map for seams greater than 10 ft thick, Wilcox Group, northeast Texas. Total resources are 269 million short tons (245 million t).

Figure 11. Resource map for seams 2 to 3 ft thick, Wilcox Group, northeast Texas. Total resources are 4,245 (excluding reservoir tonnage) and 4,365 (including reservoir) million short tons (3,859 million t and 3,968 million t, respectively).

Figure 12. Resource map for seams greater than or equal to 3 ft thick, Wilcox Group, northeast Texas. Total resources are 7,211 (excluding reservoir tonnage) and 7,272 (including reservoir) million short tons (6,555 million t and 6,611 million t, respectively).