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Geology and Hydrology of the Preglacial Channel Aquifer in Northern Daviess County, Missouri

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by
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Geological Survey and Resource Assessment Division
Water Resources Program
Rolla, Missouri
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INFORMATION**

The wells that produce water for the city of Coffey, Harrison County PWSD #2, and Continental Grain are located in a buried preglacial channel in north-central Daviess County. This buried aquifer is the former alluvial channel of the ancestral Grand River, which flowed through this region before glaciers deposited drift over it. Following deposition of the drift the streams started flowing again, although in slightly different channels (see Plate 1). The buried channels can potentially produce high volumes of water because they contain buried lenses of clean sand and gravel. Most of the surrounding glacial drift also contains sand and gravel, but it is mixed with silt and clay that reduce the aquifer's ability to yield significant amounts of water. Therefore, the best chance for developing a public water supply lies in the buried preglacial channels.

In the late 1950's the Missouri Geological Survey completed a study to determine the thickness of the glacial drift and where the buried channels are located. They drilled a series of test holes throughout northwestern Missouri down to the Pennsylvanian age bedrock. From these data they compiled county maps showing bedrock elevation and preglacial channels. The channel in the study area is believed to be larger than originally depicted, but for this current study the channel area as depicted in 1957 will be used (see Plate 2).

Cross sections made through this preglacial channel are included in this project. Cross section B-B' in Figure 1 depicts how the entire buried channel is believed to appear beneath the town of Coffey. Notice how the surface of the Pennsylvanian System is scoured as a river channel would be and that the clean sand and gravel areas are concentrated there. The drift that is on either side of the preglacial channel has sand and gravel as the main channel does, but it is filled with silt and clay also. The same can be seen in cross section A-A' in Figure 2 that is drawn through the test holes drilled by Layne-Western in 1985 for the water supply district. Figure 2 is more detailed but does not cross the entire preglacial channel due to a greater well density. Both cross sections show where higher yields are possible and where existing wells have already been constructed (in the locations where the clean sand and gravel is the thickest). In Figure 1 the city of Coffey wells were drilled into a clean sand and gravel zone as was well #1 and the DGLS observation well of the Harrison Co. PWSD. The other PWSD wells as well as the Continental Grain wells were almost certainly completed in similar sand and gravel zones.

In evaluating the possibilities of expanding the Harrison Co. PWSD, we had to estimate the amount of water in the preglacial channel, the recharge into the channel, and compare these with the amount of water being produced from the channel (see Appendix A). The volume in the preglacial channel was determined by multiplying the surface area of the channel (as defined by the 1957 Geologic Survey study and shown in Plate 2) by the average saturated thickness of the channel (determined from the testholes by the Geologic Survey and Layne-Western). The total volume of the channel includes the earth materials plus the water. To calculate the volume of water the total volume of the channel was multiplied by the assumed specific yield of the aquifer, 15 percent. This yielded the estimated volume of water stored in the preglacial channel aquifer. These calculations resulted in an estimated 59300 million gallons of water stored in this portion of the preglacial channel.

Recharge was estimated by assuming an average annual recharge of two inches over the surface of the recharge area (pink and yellow areas on Plate 2). The volume of the recharge is estimated to be 1100 million gallons per year.

Water usage from this preglacial channel was determined by querying the major water users database located at the Division. The most recent production values from the City of Coffey, Continental Grain, and Harrison Co. PWSD wells totaled 135.1 million gallons of water per year.

According to these figures it appears that the annual usage from this aquifer is 964.9 million gallons less than annual recharge. Assuming this, the only potential problem with water to additional customers would be locating new wells too close together so that they interfere with one another.

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Volume Calculations for the Preglacial Channel in Northern Daviess County, MO

The area of the preglacial channel in northern Daviess Co.^a that is believed to have the highest yield potential (yellow area on plate 2) was reproduced in ArcView and the surface area calculated at 6071 acres. The number of acres was then converted to square feet:

$$6071 \text{ acres} \times \frac{43,560 \text{ ft}^2}{\text{acre}} = 2.64 \times 10^8 \text{ ft}^2$$

The square footage was then multiplied by the average thickness of the channel (200 ft) as determined from test holes drilled by Layne-Western in 1985 to obtain the volume:

$$2.64 \times 10^8 \text{ ft}^2 \times 200 \text{ ft} = 5.28 \times 10^{10} \text{ ft}^3$$

The volume in cubic feet was then converted to gallons:

$$5.28 \times 10^{10} \text{ ft}^3 \times \frac{7.481 \text{ gal}}{\text{ft}^3} = 3.95 \times 10^{11} \text{ gal}$$

This volume in gallons was then multiplied by a specific yield of .15^b to get the total volume available in the channel:

$$3.95 \times 10^{11} \text{ gal} \times .15 = 5.93 \times 10^{10} \text{ gal} = 59300 \text{ million gallons available}$$

The assumed recharge area (pink area plus yellow on plate 2) of the preglacial channel^a was also reproduced in ArcView and the surface area calculated at 20,217 acres. The acres were then converted to square feet and multiplied by an assumed average annual recharge of two inches per year (runoff plus evapotranspiration subtracted from total rainfall) to obtain the annual recharge:

$$20,217 \text{ acres} \times \frac{43,560 \text{ ft}^2}{\text{acre}} \times \frac{.1666 \text{ ft}}{\text{year}} = \frac{14.7 \times 10^8 \text{ ft}^3}{\text{year}}$$

then converting to gallons:

$$\frac{14.7 \times 10^8 \text{ ft}^3}{\text{year}} \times \frac{7.481 \text{ gal}}{\text{ft}^3} = \frac{1.1 \times 10^9 \text{ gal}}{\text{year}} = 1100 \text{ million gallons of recharge per year}$$

The current annual usage from this preglacial channel aquifer reported to the major water users database at the Geologic Survey and Resource Assessment Division.

City of Coffey	9.7 million per year	9.7
Continental Grain	23.4 million per year	23.4
Harrison PWSD #2	102.0 million per year	225,000,000
	135.1 million gallons per year	<hr/>
		248,400,000

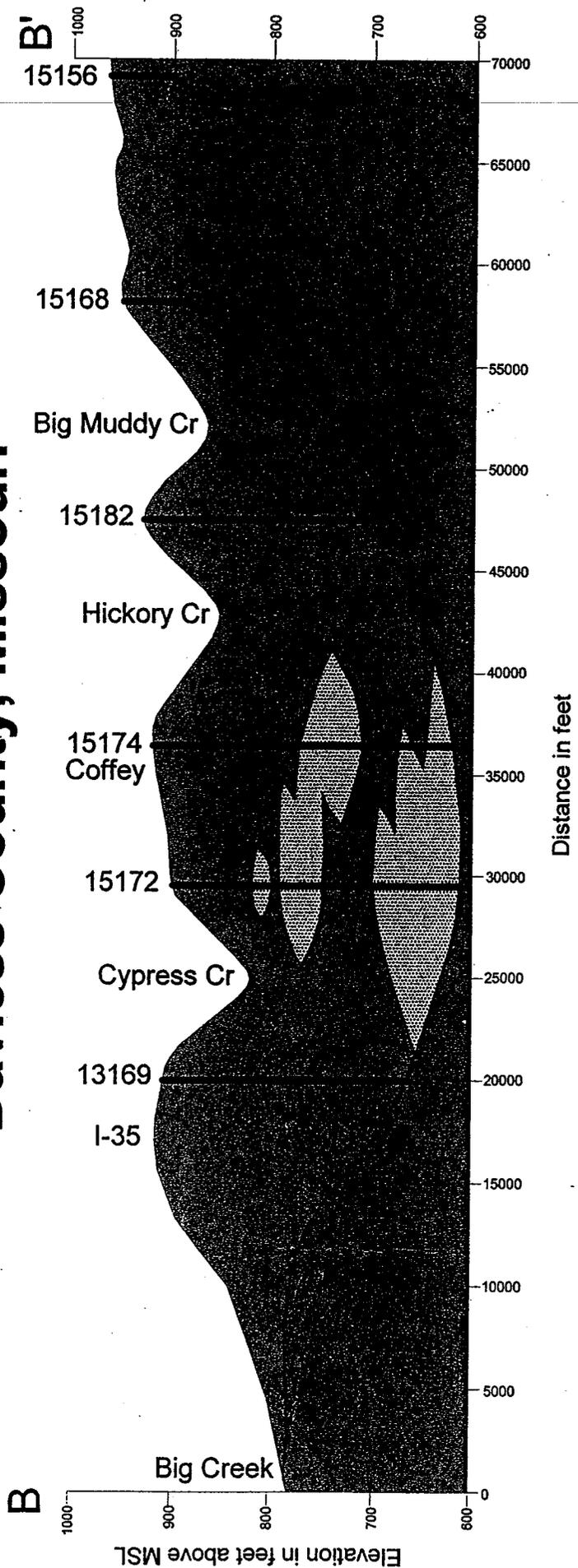
Assumed annual recharge in excess of current annual usage by 964.9 million gallons per year (1100 million – 135.1 million = 964.9 million).

^aFuller, D.L.; McMillen, J.R.; Pick, H.; and Russell, W.B., 1957, *Water Possibilities From the Glacial Drift of Daviess County*, Missouri Geological Survey and Water Resources, Water Resources Report No. 9, plate 1 and 2.

^bMiller, D.E. and Vandike, J.E., 1997, *Groundwater Resources of Missouri*, Missouri Department of Natural Resources, Division of Geology and Land Survey, Water Resources Report No. 46, p.158.

Figure 1

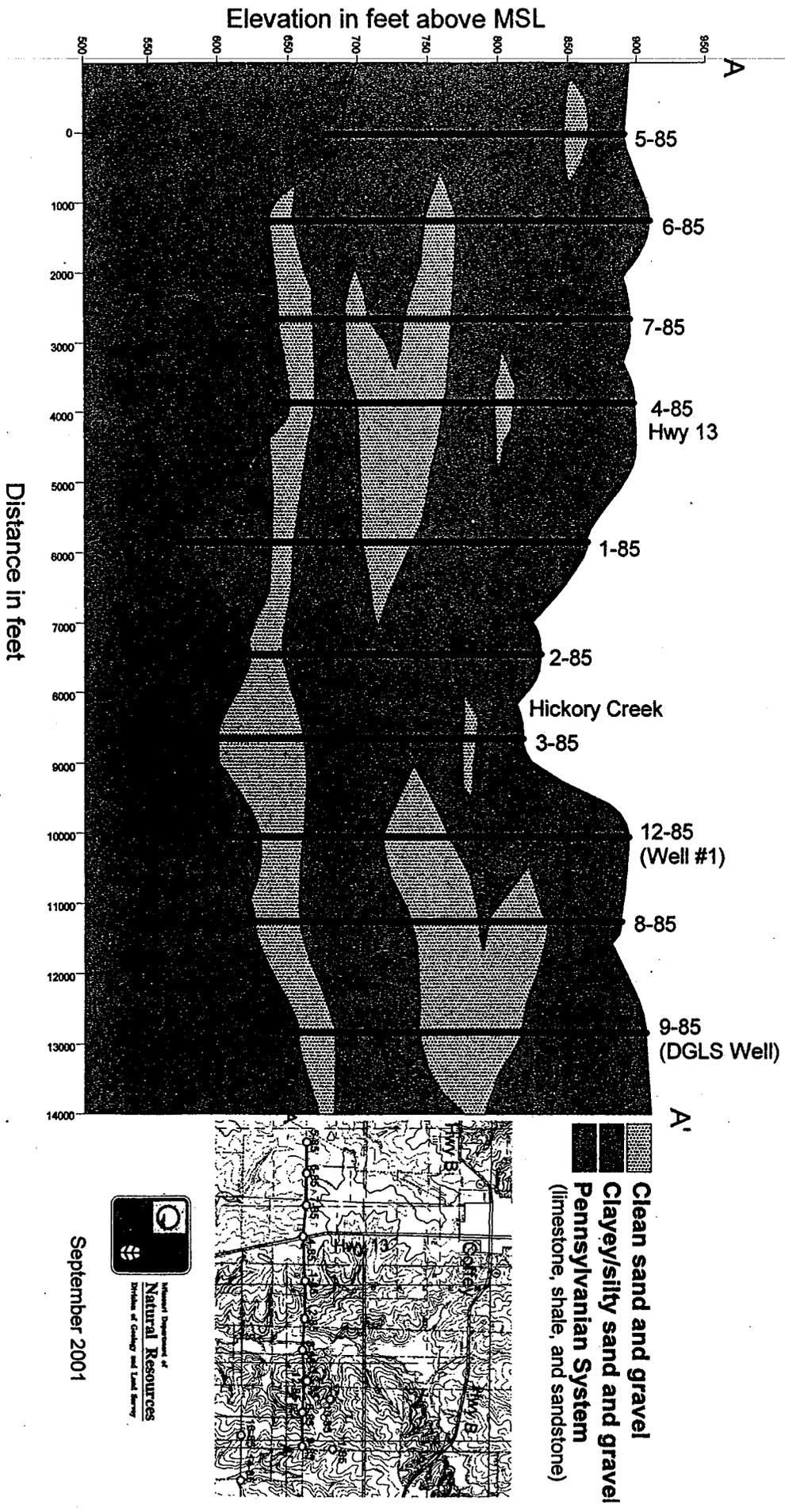
Cross Section B-B' Through Preglacial Channel Along Test Holes Drilled by Missouri Geologic Survey Davies County, Missouri



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Figure 2

Cross Section A-A' Through Preglacial Channel Along Test Holes Drilled for Harrison Co. Public Water Supply District Daviness County, Missouri



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