Water Beneath Us

Specialist Offers Unique View Of Missouri's Underground Aquifers

BETTY VALLE GEGG-NAEGER
MidAmerica Farmer Grower

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Millions of people travel the highways and byways and never realize the length, width and depth of rivers and streams flowing beneath the earth. Jim Vandike, chief of the ground water section with the DNR Water Resources Center in Rolla, recently provided a mental picture of what's flowing beneath the earth's crust.

In a general ground water talk, he said the southeastern lowlands have considerably different ground water conditions than most of the rest of the state.

"There are different aquifers here than you'll find in the Perryville area," he said. So I'll discuss what aquifers are available and where those are found, their depths and their yield and water quality characteristics."

The deepest one is called the McNairy Aquifer and it's located in the southern 75 percent or 80 percent of the southeastern lowlands. It gets deeper in the subsurface farther to the south. It's used principally for municipal supply and by water districts because of it's good water quality. It has naturally soft water and doesn't require much treatment, except farther to the north like around Bloomfield and Dexter where it's shallow and does need treatment for iron removal.

"Above that is an aquifer called the Wilcox aquifer that's not widely used in the southeastern lowlands," Vandike said. "It's also used mainly for municipal water supply and some water districts where the McNairy is not available, or is too deep or has poor water quality."

The Wilcox is a very prolific aquifer. It can yield large quantities of water but the wells have to be quite a bit deeper than the alluvial wells, so it's more expensive to access the water. Sometimes that makes it better for the cities who must treat the water for iron and manganese removal, because the iron content in the Wilcox is a little more constant than it is in the shallower Alluvial aquifer.

"The aquifer that we'll be talking mostly about today is the Alluvial aquifer, the Southeastern Lowlands Alluvial Aquifer we call it, and this is an unconsolidated sand and gravel deposit that is basically like the alluvial deposits next to the Missouri and Mississippi rivers on the floodplains," he explained. "It has sediments that were laid down by the actions of the rivers going through this area back and forth in the last million or so years. It's anywhere from zero to more than 250 foot thick. It's typically thickest on the east side of Crowley's Ridge, and a little thinner on the west side; but it is available on both sides of Crowley's Ridge and it covers over 90 percent of the southeastern lowlands. The only place you don't find the Alluvial aquifer is up on Crowley's Ridge, Benton Hills and Hickory Hills."

The Southeastern Lowlands Alluvial Aquifer extends on south down into Arkansas. Going farther south there's more and more units added on top.

"In other words, the Wilcox here is more in the subsurface; as you go south, it has on top of it the Memphis sand, then the Sparta sand and all these other units," Vandike explained. "We're right at the northern end of what we call the Coastal Plains Province. And so, from Cape Girardeau on south we're starting off with just a fairly thin group of these unconsolidated sand and gravel units, and the farther south you go the thicker they get."

With such heavy use through irrigation and by water districts, it's natural to wonder whether the water will continue to be there.

"The Alluvial aquifer especially gets a lot of recharge from precipitation because in this area the water table is commonly 5 to 10 feet below land surface," he said. "Literally, you can dig a post hole and hit water at times during the year. The Alluvial aquifer is reasonably thick, it gets a lot of recharge from surface water. If you look at the water level in the various drainage ditches through the Bootheel most of the time that water level is basically the same as the water level is in the aquifer."

The drainage ditches were placed there as part of the draining projects done in the Bootheel many years ago to drain groundwater, get it to the lower elevations so the soils would dry out for planting. The deeper aquifers, such as the Wilcox, get their recharge from the alluvial. The Alluvial aquifer is connected, but it's usage is not very high.

"The McNairy is an artesian aquifer," Vandike continued. "It has a clay unit on top of it called the Porters Creek Clay that's very, very tight. It does not let water through very well, so it gets it's recharge where it outcrops farther from the north underneath the Alluvial aquifer, or up on Crowley's Ridge, or by getting water out of the deeper bedrock below it. But, because it's not as widely used as the other two and its principle use is for municipal water supply, it doesn't have a much demand placed on it, so we've not seen a lot of ground water decline here in the Bootheel like we have in certain areas in western Missouri, even though there is a tremendous amount of water use. A lot of that has to do not only with the aquifers themselves and the fact they contain such a large volume of water, but there's a lot of recharge in the Alluvial aquifer from rainfall on a yearly basis."

Missouri's rainfall varies from about 35 inches in northwestern Missouri to about 48 inches in southeastern Missouri, so southeast Missouri is the wettest area in the state in terms of precipitation. Also contributing to the water availability is the confluence of a number of rivers, the Mississippi River, the Caster and the White Water Rivers that flow into the north end of the Bootheel and are carried over to the Mississippi by the headwaters diversion channel. There's also the St. Francis River and the Black River both of which empty into the Bootheel.

"Back in the early 1900s this area was mostly emergent wetlands and hardwood swamps," he reported. "It was a case where there was too much water, but through the diversion channel up by Cape Girardeau and the construction of Wappapello and Clearwater lakes which catch the runoff before it comes to the Bootheel and the development of the Little River Drainage District and all those drainage ditches, they were able to lower the water table down to where the land could be cleared and changed from swamps and wetlands into very, very productive farmland. Today what we see here is a huge farming area, but a century ago it did not look anything like this."

Vandike couldn't predict the future of the water system in Southeast Missouri, but if the past is any barometer this area will be well supplied.

"We have over 50 years of continuous water level measurements here in the Bootheel from a series of stations that we established during the drought of the 1950s," he said. "In the 50 years

Jim Vandike, Chief of the ground water section with the DNR Water Resources Center in Rolla, describes in detail the rivers and streams that flows beneath the earth's crust.

Photo by John LaRose

of data collected from the Alluvial aquifer here we've seen very, very little net change in ground water level. It's pretty hard to dispute the data. There is an awful lot of water being used, but it is a very prolific aquifer and it gets a lot of recharge; and the data basically shows that the Alluvial aquifer has been very stable during that time."

There has been a little bit of head decline in the McNairy aquifer because it is an artesian aquifer. Removal of a small amount of water will cause that artesian head to drop down. It's a pressure phenomenon.

"We don't have enough information from the Wilcox to really tell," he added. "We've added new observation wells since 2000, we have three of them into the McNairy aquifer now and one of them into the Wilcox and prior to that we did not have any permanent water level installations in those. So as time goes on we'll be collecting more information from them, but I'd say currently everything looks pretty good. It's been a very wet year, there wasn't nearly as much irrigation done in 2009 as there has been typically, so it leaves us in a very good situation going into next year I think."

Vandike explained the meaning of the term alluvial:

"It's just a term that is used to describe the sediments deposited by the actions of a modern river. Just imagine a sand and gravel deposit with silts and clays at the top that the river lays down during overbank flooding periods. These deposits were laid down at the end of the ice age and there was lots of melt water coming off of glaciers to the north. There was tremendous am-ounts of sediment generated and a lot of it was laid down at that time; and today whenever the river gets out of its banks, if it's ever allowed to with all the levees and everything, it is always going to deposit the sands and silts and the clays that are carried with that water out on the floodplain.

"The river is moving fast in the channel but once it spreads out over its floodplain the water slows down and doesn't have the velocity necessary to keep those sediments in suspension so they'll settle out and add more to it," he continued. "Alluvial is just a geologic term that means the sand and gravel deposits that are associated with the modern river."

The Alluvial aquifer in Missouri basically goes from what is called the Ozark Escarpment – the area where there is bedrock outcropping over by Cape Girardeau. From the south it reaches north to the Missouri River; of course over on the Illinois side it extends on over and to the south, the alluvial aquifer goes all the way to the gulf coast. It's just a continuous deposit.

Vandike couldn't comment on the rumor that there's salt in the aquifer in Arkansas.

"I don't know too much about what's going on down there. I know Arkansas instituted some laws here a few years ago basically regulating water use. I don't think it had to do with the alluvial aquifer, I think it was in some of the deeper sediments, but I spend most of my time dealing with Missouri and see a little bit about Arkansas but don't really know too much about what their individual situation is there.

"We haven't seen any water quality problems here to speak of," he continued. "The only saline waters that we have a problem with are in the McNairy formation and it's partly in New Madrid and a little bit over into Stoddard county. That's probably where there is faulting below it associated with the New Madrid seismic zone allowing salt water into the deeper bedrock to come up into those units, but it doesn't extend on up into the Wilcox as far as we know. And it's just an area in which the chloride content gets too high for cities to use that water. It's not terribly high but it is high enough that it keeps them from using it for a water supply." Δ

BETTY VALLE GEGG-NAEGER: Senior Staff Writer, MidAmerica Farmer Grower