

## Ground Water Systems of West Tennessee

The Earth's six billion people already over tax its supply of accessible fresh water.



Farmers and municipalities are pumping water out of the ground faster than it can be replenished



The United Nations said that 2.7 billion people would face severe water shortages by 2025



1.2 billion people drink unclean water...more than five million people die each year from water-related diseases

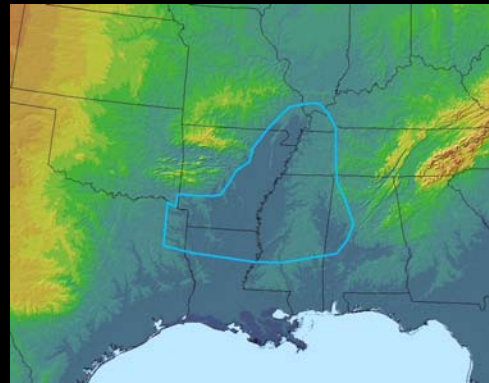


Source: National Geographic, Sept. 2002

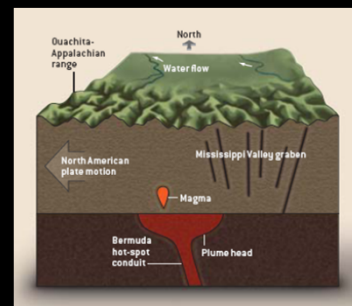
Memphis and the Mid-South region is fortunate to have some of the best and most abundant ground water in the world!



### The Mississippi Embayment

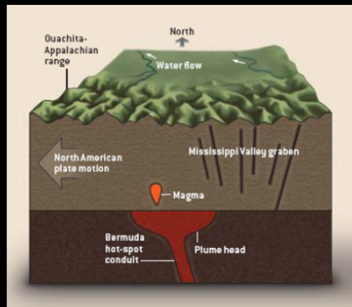


### Step 1



In the early Cretaceous, the plume of hot, rising rock engendered by the Bermuda hot spot was located west of the Mississippi Valley graben, a zone containing ancient, steeply inclined faults.

Step 1



The presence of the high-standing Ouachita-Appalachian range forced the rivers that drained the interior of the continent to flow north or west to the sea.

Step 2

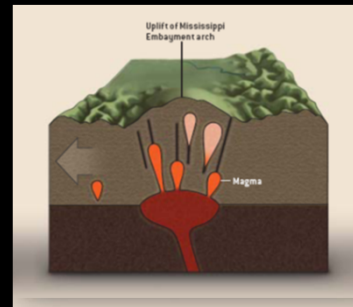
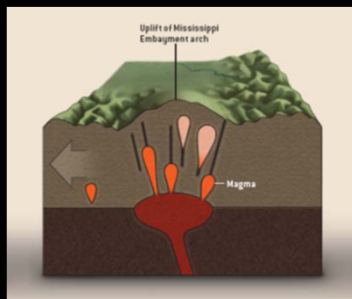


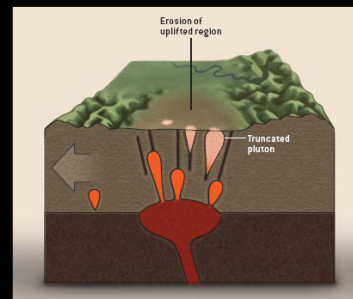
Plate tectonic motion brought the Mississippi Valley graben over the Bermuda hot spot in the mid-Cretaceous, when the activity of such deep-seated heat sources was heightened worldwide.

Step 2



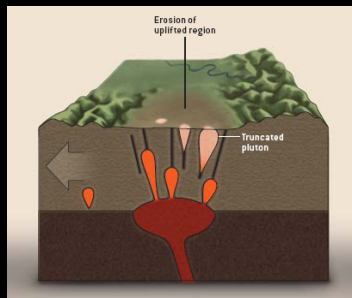
Magma flowed up along the faults, inflating this region with added material, while simultaneously causing the upper part of the plate here to expand thermally. The result was a broad zone of uplift—the Mississippi Embayment arch.

Step 3



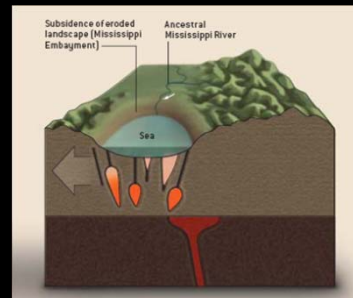
The ever present forces of weathering soon eroded the newly uplifted terrain. This lowering of what had been a high-standing, mountainous arch truncated the tops of some igneous "plutons."

Step 3



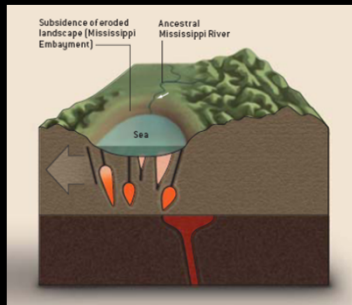
These bodies of crystalline rock were formed earlier by magma that rose from great depths but cooled and solidified before reaching the surface. Their truncation is one sign that erosion occurred.

Step 4

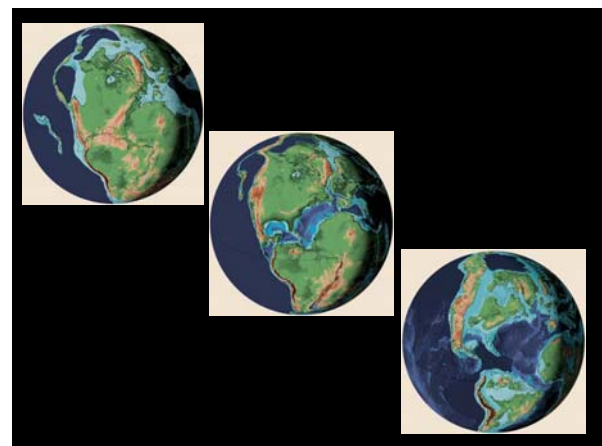
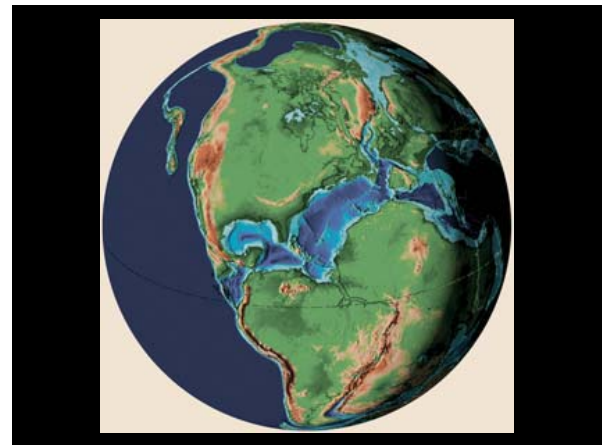


In the late Cretaceous, after the Mississippi Valley graben moved away from the Bermuda hot spot, the region that had been uplifted cooled and subsided, allowing the sea, which stood relatively high at the time, to flood the area.

Step 4



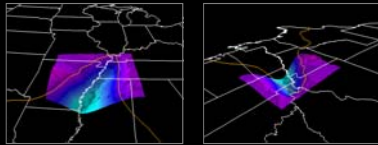
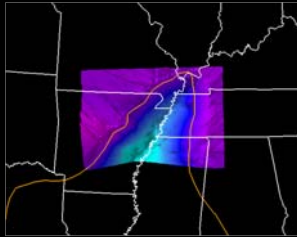
Rivers draining the continental interior, including the ancestral Mississippi, could now flow southward, into the new embayment, which gradually filled with sediment.



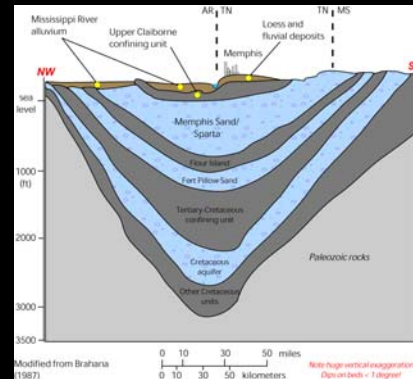
## The Mississippi Embayment

The basin is shallow and narrower toward the north and increases both in depth and width toward the Gulf of Mexico

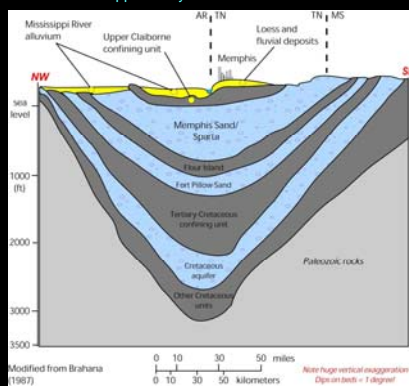
Axis of the embayment parallels the current location of the Mississippi River



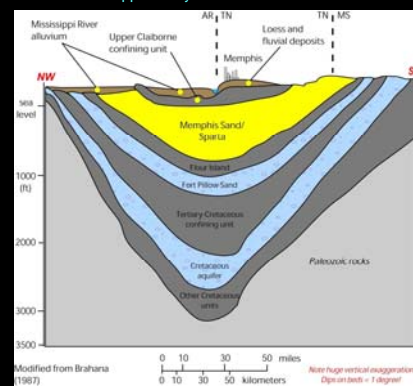
## Cross-section of the Mississippi Embayment



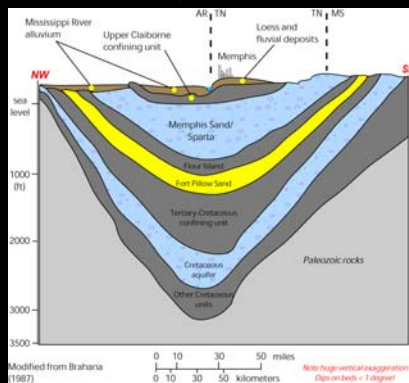
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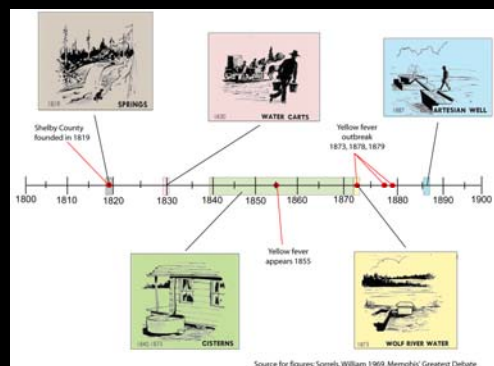
## Cross-section of the Mississippi Embayment



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## Early drinking water usage







A Memphis aquifer flowing well

Yellow fever epidemics forced Memphis to look for a better water supply than the Wolf River

The Memphis Water Company tried to find a new source of water for years, to no avail.

But on March 18, 1887, while sinking a well for Richard C. Graves at the Bohlen-Huse Machine and Lake Ice Company, the drillers tapped the artesian water supply which existed underneath the city.

The water was found to be pure and plentiful. Memphis had discovered its single, greatest resource, one that would do more to increase the health and development of the city and its residents than any other factor.



A Memphis aquifer flowing well

A company was organized to supply water from wells, and after successful experiments, they were able to contract with the authorities in July 1887. This new company took the name of "The Artesian Water Company," and agreed to supply water to the city and to individuals.

In 1890 a first-class pumping station was started and the Memphis water supply became one of the best supplies in the world.

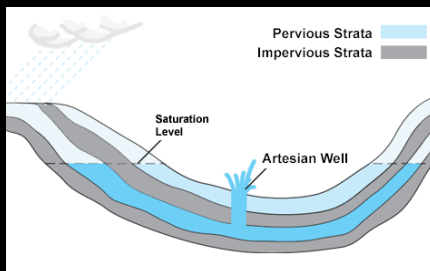


Flowing well in Jackson, TN (2002)



Drilling rig used around the turn of the century for well installation into the Memphis aquifer

How does an Artesian Well Work?



Artesian Water Pumping Station



In the 19th century, Memphis was a filthy, inhospitable city.

Garbage and carcasses of dead animals were tossed around the town including the Bayou Gayos which provided water to some of the citizens of Memphis

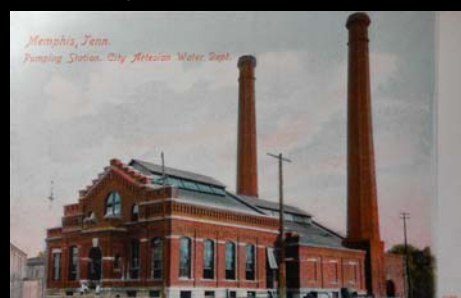
Artesian Water Pumping Station



After the yellow fever epidemics of the 1870s, Memphis decided to clean up the city. The aquifers were discovered by the Bohlen-Huse Ice Company in 1887.

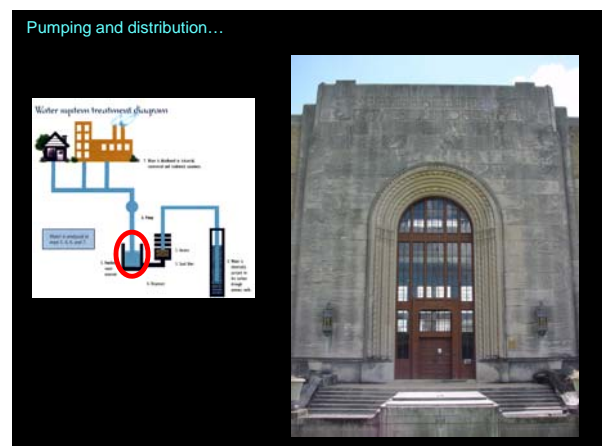
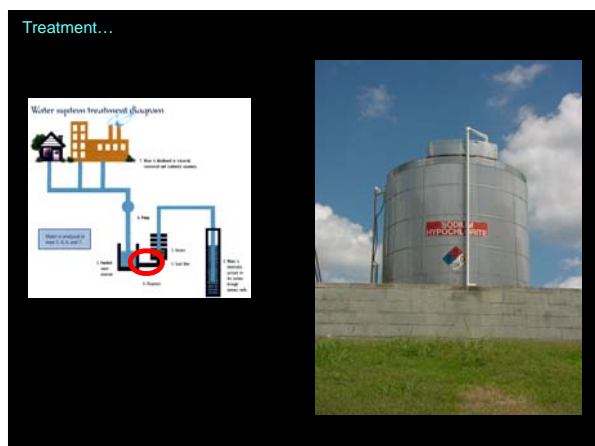
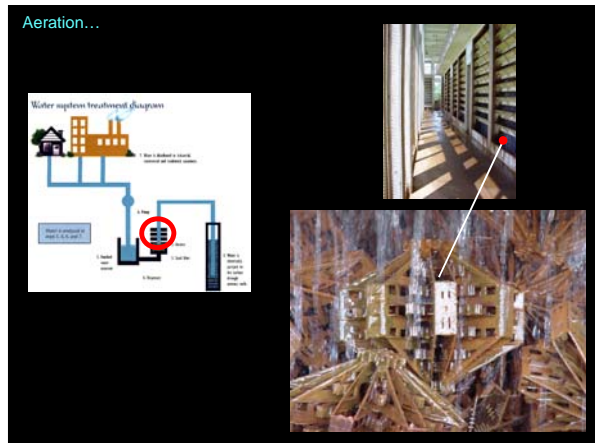
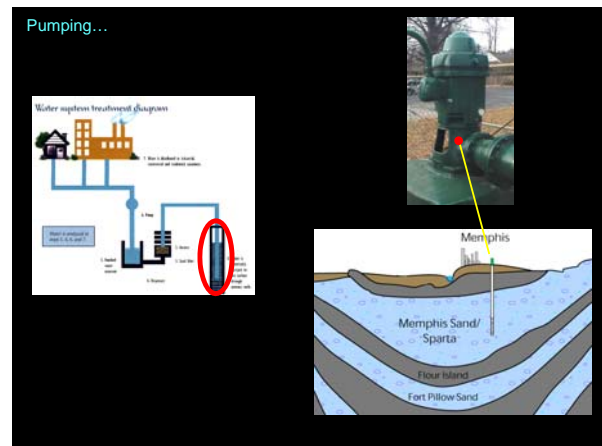
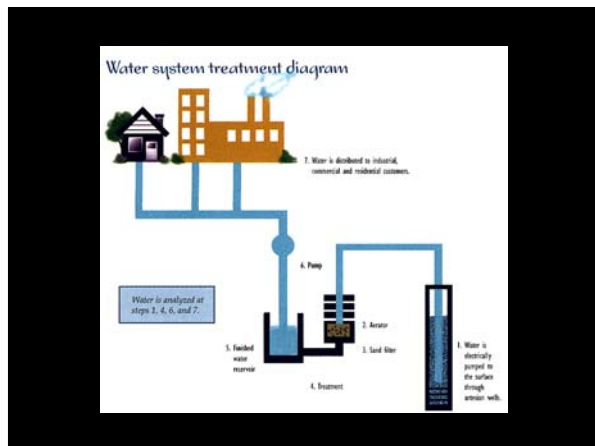
The building above was constructed in 1890.

Artesian Water Pumping Station



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More than 180 wells have been drilled into the Memphis Aquifer to supply drinking water for people of the area. Ground water from the Memphis Aquifer is considered to be some of the best in the country.

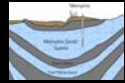
The Sheahan Pumping Station by the U of M is the station that supplies Central Gardens



This is one of MLGW's oldest. It was built in the 1930s on an old plantation. (The plantation house and barn are still adjacent to the pumping station, but they have been modernized considerably.)

Sheahan has three separate buildings—one for pumping, one for aeration, and another for filtering.

Shelby County and the surrounding region is well known for the quality and abundance of drinking water



However, USGS studies have indicated breaches in the confining unit once thought to protect the Memphis aquifer

These breaches or "windows" are where the confining clay thins or becomes absent

The windows provide a short circuit pathways for contamination to enter the Memphis aquifer

Note Memphis aquifer source water area



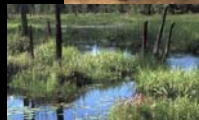
Source: USGS WRI 90-4092

As development encroaches east, water demand increases and the potential for ground water contamination increases



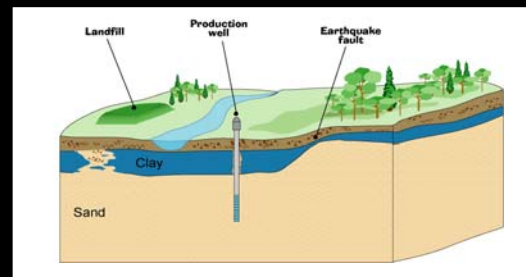
Man-made sources of pollution in the Memphis aquifer source water area have a direct path to the aquifer

Grading and land surface reshaping can result in a reduction of recharge to the Memphis aquifer and an increase in runoff to streams and rivers

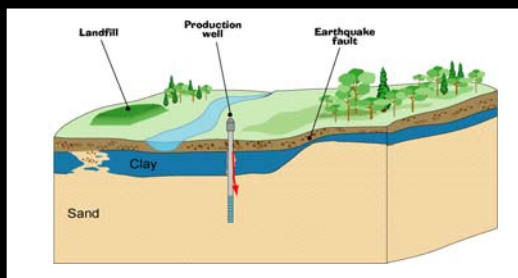


Reduced ground water levels can affect wetland habitat

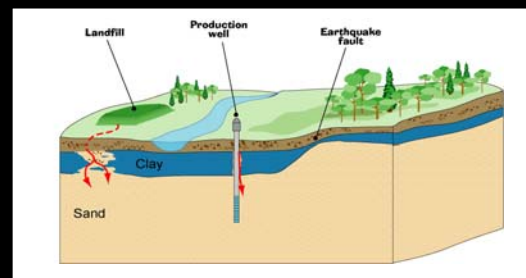
Potential sources of contamination to our drinking water aquifer in a confined system



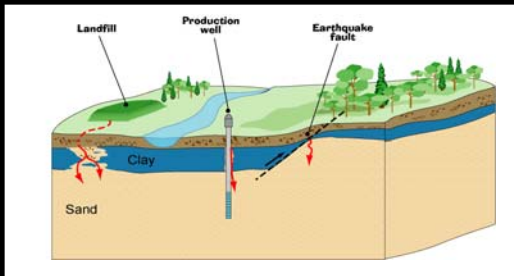
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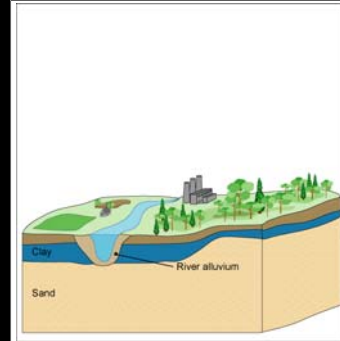
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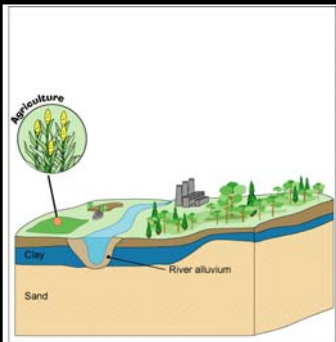
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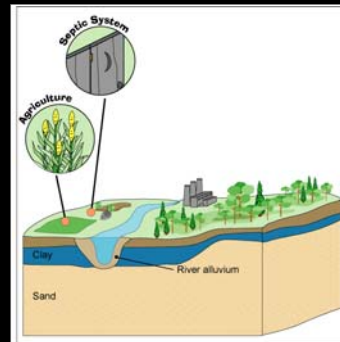
Point/non-point source pollution of rivers with subsequent transport of contaminants to the aquifer



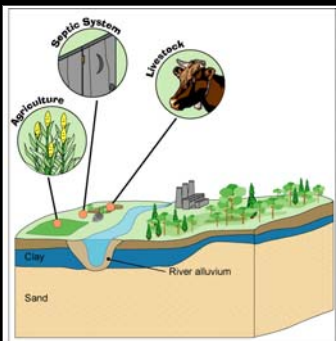
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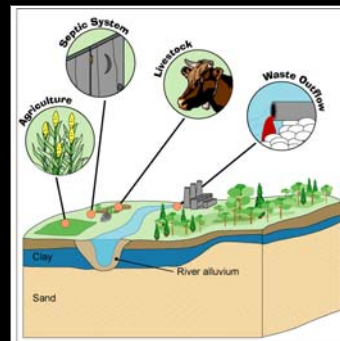
Point/non-point source pollution of rivers with subsequent transport of contaminants to the aquifer



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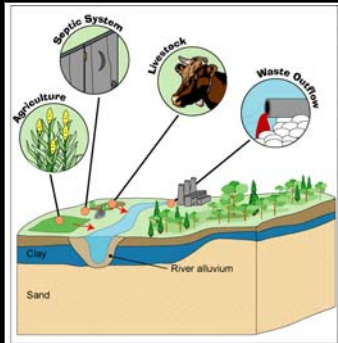


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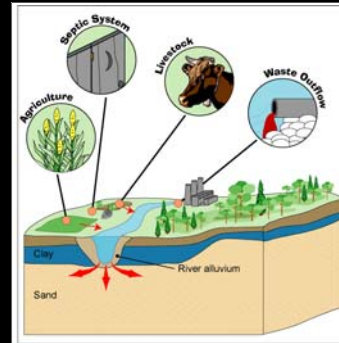




Point/non-point source pollution of rivers with subsequent transport of contaminants to the aquifer



Point/non-point source pollution of rivers with subsequent transport of contaminants to the aquifer



### Center for Applied Earth Science and Engineering Research (CAESER)



CAESER evolved from the Ground Water Institute which was founded in 1992 in response to a need for regional ground water management in West Tennessee

#### Mission:

Understand, improve, and protect current and future ground water quality and quantity through research, education and application

#### Pursuit of our Mission



Provide information regarding water resources and GIS technology to the local and regional community



Expand the graduate program by adding new curriculum and by actively seeking graduate students both at the Master's and Doctoral level



Continue to refine our knowledge of the Memphis aquifer and other aquifer systems within the Mississippi embayment



CAESER is committed to addressing the potential and current threats to our aquifer systems

We do this through research and education.



#### Accomplishing our Mission

##### CAESER facilities



Student workers in our GIS computational lab and our ESRI Authorized training center



Soil and water chemical analysis facilities within the Department of Earth Sciences, an inter-departmental effort



Our facilities are not always indoors  
Research sites in Fayette County and at Shelby Farms

### Other Resources

- Local CAESER and groundwater Information
  - <http://strengthencommunities.com/>
  - <http://water.usgs.gov/wsc/>
  - <http://www.state.tn.us/environment/>
  - <http://www.mlgw.com/publications.htm>