Newsletter

2016 Annual Meeting Preview

Lover's Leap, Hannibal MO
From the MGS Photo Archives

A Note from the President

I would like to begin by briefly reflecting back on the 2015 annual meeting. The Friday and Saturday field trips and the evening meal presentation were all focused on water resources, predominantly in Clay and Platte counties. Topics included groundwater in the Missouri River Alluvial Aquifer, groundwater monitoring, construction of a public water supply lake, wetland site data collection, host material of a glacial drift spring, and mineralized waters of Excelsior Springs. I hadn't realized this when putting together the stops for the field trip, but AMG has never had a field trip in northwest Missouri focused on water resources. That may not be surprising since water resources are limited in this part of the state. There have been eight previous meetings/field trips in the Kansas City-St. Joseph-Maryville region. These meetings focused on the oil and gas industry, limestone mining and underground storage, or Pennsylvanian stratigraphy.

Hall of Waters, Excelsior Springs, MO

Many staff from the Missouri Department of Natural Resources' Water Resources Center (WRC) assisted with various logistic for this event. I extend special thanks to Cynthia Brookshire, Scotty Baumgartner, John Horton, Kurt Hollman, Tracey Mason, and Hairl Dayton for their work planning field trip stops and making Saturday lunch arrangements. Also a big thank you to Joey Rosenfelder who presented on geologic considerations for dam construction and Rob Rohlfs who made most of the Friday meeting and meal plans. The hard work these people put forth was validated by the many thanks yous and compliments I heard on the 2015 annual meeting and associated field trips. One veteran geologist and retired university professor said he really enjoyed the weekend and made the comment, "I didn't know these sites existed in Missouri!"

Moving on to the present, Ryan Mueller is this year's President-elect. Ryan graduated from the University of Missouri-Rolla (now Missouri University of Science & Technology) with B.S. and M.S. degrees in geological engineering. He is currently the executive director of the Interstate Council on Water Policy (ICWP). Before joining ICWP in January 2015, Ryan served as the director of WRC where he was responsible for oversight of state water planning, water resource monitoring, water policy coordination, and oversight of dam and reservoir safety. He has also worked for over a decade in the private sector as an environmental engineer, including time at Continental Cement near Hannibal as well as serving as a research assistant and lecturer at the University of Missouri-Columbia.

Clarence Cannon Dam

As we visited a part of the state last year that we haven't very often, this year we plan to hold the annual meeting in Hannibal with field trips in the area. All or some of these stops will be included in the field trip: a tour of Clarence Cannon Dam with a discussion on geologic considerations when constructing the dam and water quality issues in the Salt River, visit to Continental Cement to tour their quarry and cement processing facility, tour of Army Corp of Engineers' Lock and Dam #22-Saverton, stop at Lovers' Leap where the Louisiana Limestone, Hannibal Shale, and Burlington-Keokuk Limestone are exposed, and finally a stop at Mark Twain and Cameron caves. AMG has only held their meeting in northeast Missouri twice, with the last being in 1999. The meeting will be held September 30th—October 1st. We hope you all can join us then.

Scott Kaden

Missouri Geologists' Consortium

Since our last report, the MGC held three planning meetings in Columbia, Missouri. The MGC meetings have been well attended with representatives of academia, consulting, state and federal agencies, and retirees. First, we encouraged those interested, and qualified, to consider applying for one of the vacant seats on the Missouri Seismic Safety Commission. Several people visited with legislators (or their assistants) to make them aware of the Commission and what its purpose is. We continued to develop a list of affiliated societies, both to educate about the mission of the MGC, and also to learn what their needs are and how we can combine efforts. We continued to track legislation. Luckily, we did have some success in staying in front of a few MDNR-related bills, and Senate Bill 669, which would have effectively eliminated funding for the Board of Geologist Registration. Thanks to the folks who testified against SB 669. We need volunteers for the next session to help sort through the dozens of bills that come up. We have developed a simple program that can be used to search for key words, and we keep a running spreadsheet updated, on-line, so that people can easily see which bills have already been reviewed. We look forward to seeing you at our next meeting on Saturday, October 22, 2016 at the Boone County Library in Columbia, Missouri at 10:00 am.

Please feel free to visit our website https://mogeologists.wordpress.com and/or share your thoughts.

Duane Kreuger, Chair [dkreuger@geotechnology.com]

2016 Award Winners

The O.R. Grawe Award for Outstanding Undergraduate Geology Student was awarded to two students: Alyssa Flotron of Missouri State University and Wilhelm Fraundonfer of Northwest Missouri State University. The Clayton H. Johnston Award for the best graduate student paper presented at the Missouri Academy of Sciences was awarded to Brandon Ives of Missouri State University.

Several students attended the annual meeting and presented their research in a poster contest sponsored by the Missouri chapter of the American Institute of Professional Geologists (AIPG). The winners were:

- 1st place – Spourav Nandi, Missouri State University: *Large-scale cyclicity in gamma-ray and magnetic susceptibility*
- 2nd place – James Dunahue, University of Missouri-Kansas City: *Topographic lineaments, near-surface geophysics, and possible fault rupture along the Cottonwood Grove Fault in the New Madrid seismic zone*
- 3rd place – Jameelah Rodriguez, Missouri State University: *Metal contamination of sediment: effect of pH, color, and organic matter in metal contamination in Aurora, Missouri*

AIPG Poster Contest

AIPG will be paying the AMG banquet fees for participating students and also award tuition assistance cash prizes to the top three presenters in the amount of $600, $400, and $200 for first, second and third place respectively. Undergraduate and graduate geoscience students from all Missouri universities and colleges are welcome to participate.

See the announcement on the following page for more information.

Future Newsletters

Do you have an idea for interesting article or topic that would be interesting to AMG members? Are you working on an interesting project? Perhaps you discovered your thesis or dissertation whilst dusting, or have a student that needs more writing practice. If you are (or might be!) willing to contribute to future newsletters please contact me at molly.starkey@dnr.mo.gov.

American Institute of Professional Geologists

Missouri Section

Student Poster Competition

Missouri Section

Attention Undergraduate and Graduate Geoscience Students!

The American Institute of Professional Geologists—Missouri Section (AIPG-MO) is sponsoring a Student Poster Competition in conjunction with the Association of Missouri Geologists' (AMG) annual meeting. Geoscience students from all Missouri universities and colleges are invited to participate. AIPG-MO will pay the AMG banquet meal fees for all participating students and award cash prizes of between $100 and $250 for the top four (4) posters!

Tentative Details: The Student Poster Session will take place between the AMG business meeting and banquet, tentatively scheduled for **September 30, 2016 in Hannibal, Missouri.** Final details will be posted to the AMG website soon: http://www.missourigeologists.org/

To enter, please send title and abstract to Rob Rohlfs at rrohlfs@lbgkcmo.com on or before September 24, 2016.

Note: To enter the competition, you must be a student member of AIPG.

Go to www.aipg.org to join for free!

Recharge Area of Selected Large Springs in the Ozarks

James W. Duley, Cecil Boswell, and Jerry Prewett
Missouri Geological Survey

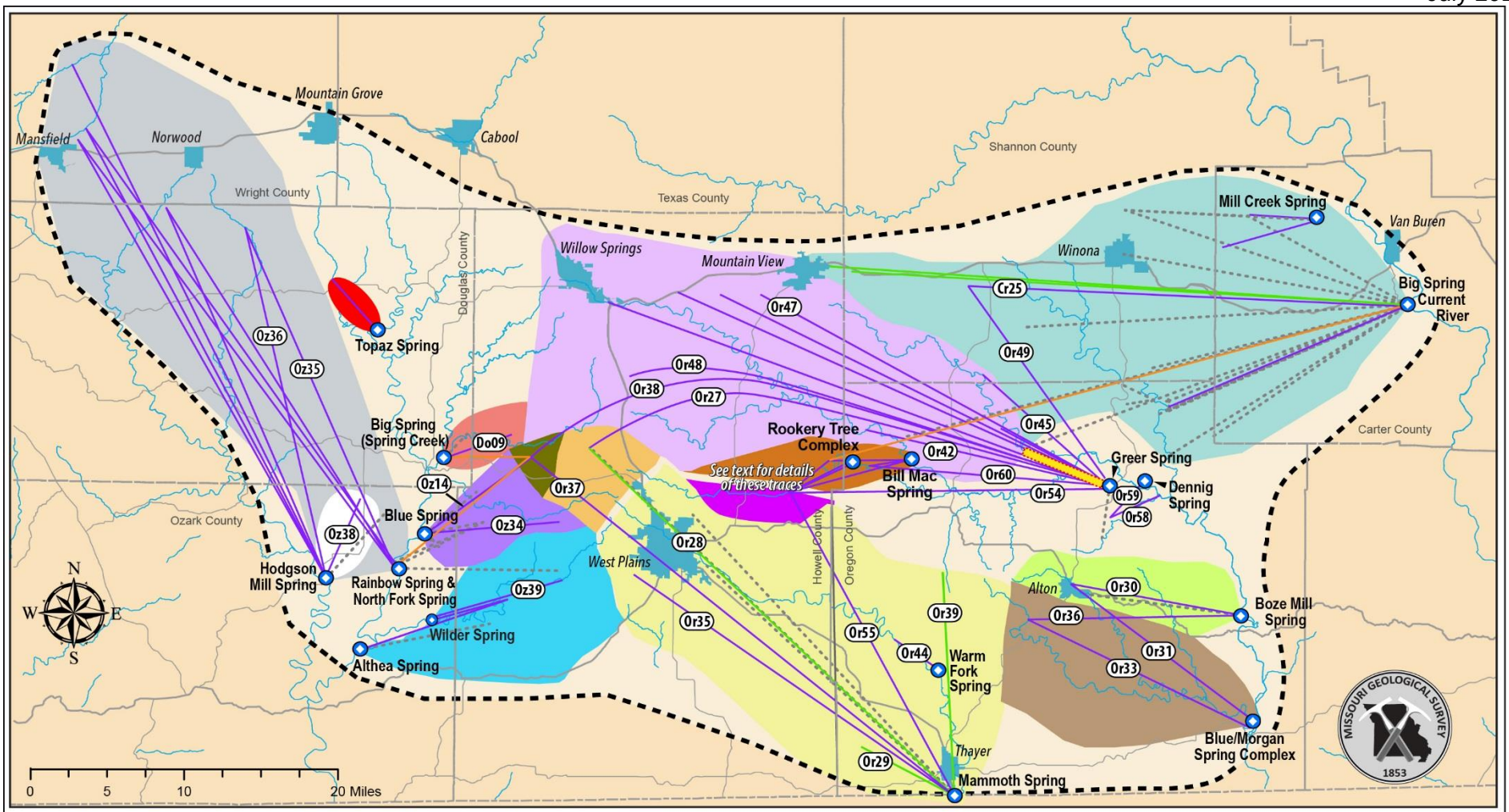
Abstract
Ongoing work by the Missouri Geological Survey (MGS) is refining the known recharge areas of a number of major springs in the Ozarks. Among the springs being investigated are: Mammoth Spring (Fulton County, Arkansas), and the following Missouri springs: Greer Spring (Oregon County), Blue Spring (Ozark County), Blue/Morgan Spring Complex (Oregon County), Boze Mill Spring (Oregon County), two different Big Springs (Carter and Douglas County) and Rainbow/North Fork/Hodgson Mill Spring Complex (Ozark County). Previously unpublished findings of the MGS and USGS are also being used to better define recharge areas of Greer Spring, Big Spring (Carter County), Blue/Morgan Spring Complex, Rainbow/ North Fork/Hodgson Mill Complex, Wilder Spring (Ozark County) and Althea Spring (Ozark County).

MGS is applying a graphical method of data analysis using spectrofluorometric scan results. Comparing the dye peak intensity to the intensity of the valley preceding the peak yields a ratio that can be used to standardize and quantify water traces. This method can be applied to current and some legacy traces with comparable results.

In some cases, past tracer injection sites were utilized in attempts to replicate older traces from those locations. The data clearly show that there is value in applying spectrofluorometric dye detection techniques in attempting to replicate older traces. Some repeat injections and subsequent monitoring confirmed earlier traces. Other replication efforts revealed multiple recovery points that were undetected by the legacy traces, thus expanding known recharge areas. Still other replication efforts indicate that some older traces are not repeatable. The effect of the replication efforts significantly changes the logical interpretation of a number of recharge area boundaries.

Among the findings of the overall study to date: Mammoth Spring and Greer Spring share a portion of their recharge, with the majority of Greer Spring's flow apparently passing under a gaining segment of the 11 Point River, ultimately emerging more than four kilometers to the southeast. This and other findings raise questions about how hydrology in the study area may be controlled by deep-seated mechanisms such as basal faulting and jointing. Research and understanding would be improved by 1:24,000 scale geologic mapping and increased geophysical study of the entire area.

For more information, please see the entire article online at:
http://scholarcommons.usf.edu/cgi/viewcontent.cgi?article=1051&context=sinkhole_2015



Area of Study

General Study Area
Spring
Inferred Conduit

Trace Methods

Trace Using Fluorescence Spectrometry
Trace Replicated Using Fluorescence Spectrometry
Trace Not Reproducible Using Fluorescence Spectrometry
Legacy Trace Using Visual Methods

Recharge Areas

Recharge Area Shared by Rainbow, North Fork and Hodgson Mill Springs
Big Spring (Spring Creek) Recharge Area
Hodgson Mill Exclusive Recharge Area
Recharge Area Shared by Bill Mac and Greer Springs
Blue Spring Recharge Area
Recharge Area Shared by Greer and Mammoth Springs
Recharge Area Shared by Greer, Mammoth and Blue Springs
Recharge Area Shared by Althea and Wilder Springs
Recharge Area Shared by Bill Mac and Mammoth Springs
Big Spring Recharge Area
Recharge Area Shared by Blue and Morgan Springs
Boze Mill Spring Recharge Area
Mammoth Spring Recharge Area
Greer Spring Recharge Area
Topaz Spring Recharge Area

The Teteseau Flats Terrace Aquifer

The April 2015 AMG newsletter contained an article describing the Lake City alluvial valley in Jackson County. East of this site, in Saline County, lies another abandoned alluvial valley. It runs from Malta Bend and passes north of Marshall, Napton, and Nelson before rejoining the Missouri River Valley west of Booneville. Like the Lake City valley, this channel developed during the Pleistocene due to glacial ice damming on the Missouri River in the Big Bend area of the river somewhere near Glasgow. The damming of the river forced water to seek a new course and carve a new channel through the bedrock. It also caused glacial ponding and associated sediment deposition at the upper end of the new channel in the Malta Bend area, which is called the Teteseau Flats Terrace (Figures 1 and 2). This terrace deposit is the focus of this article. When the ice dam melted, the river returned to its original channel and abandoned the newly created valley which was then filled with sediments. The Salt Fork now occupies this former Missouri River channel.

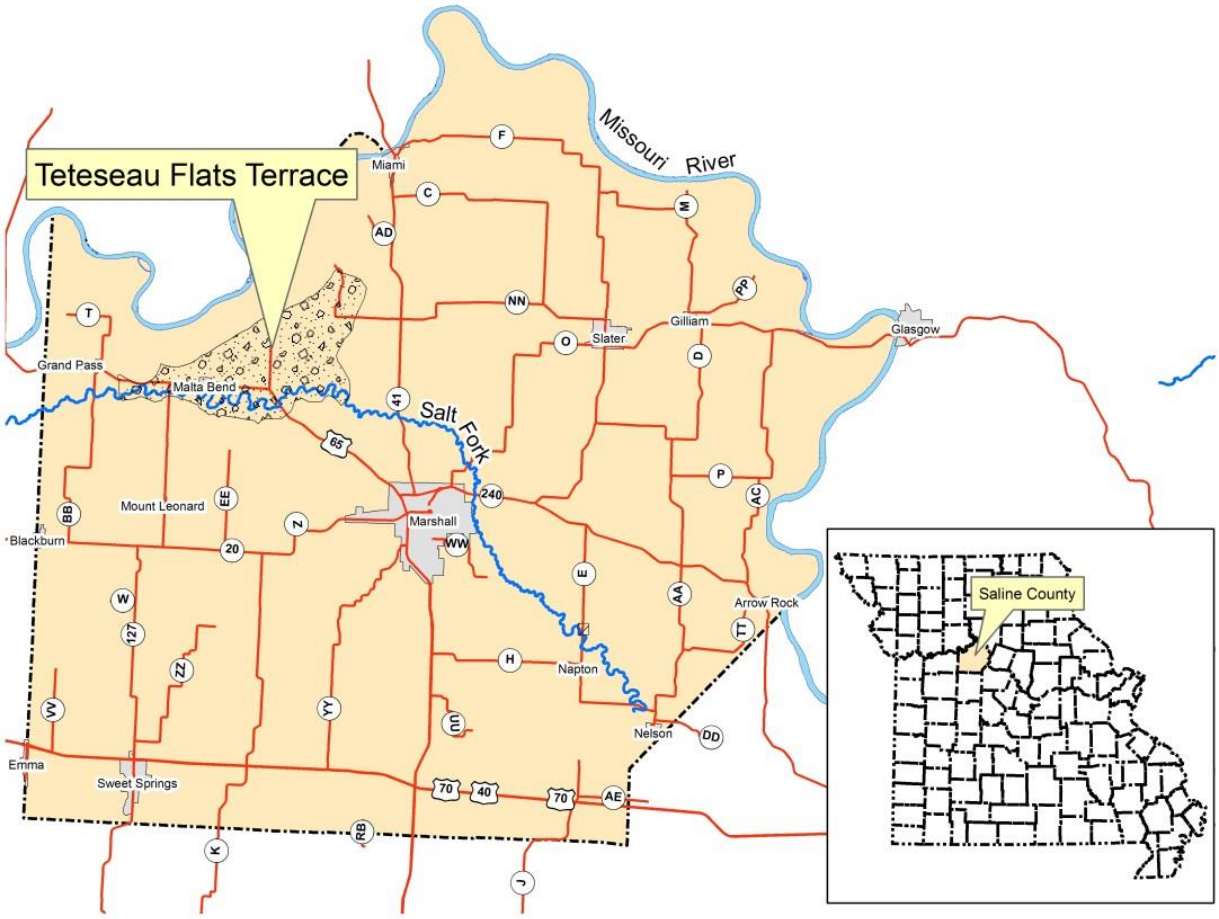


Figure 1: Location of Teteseau Flats

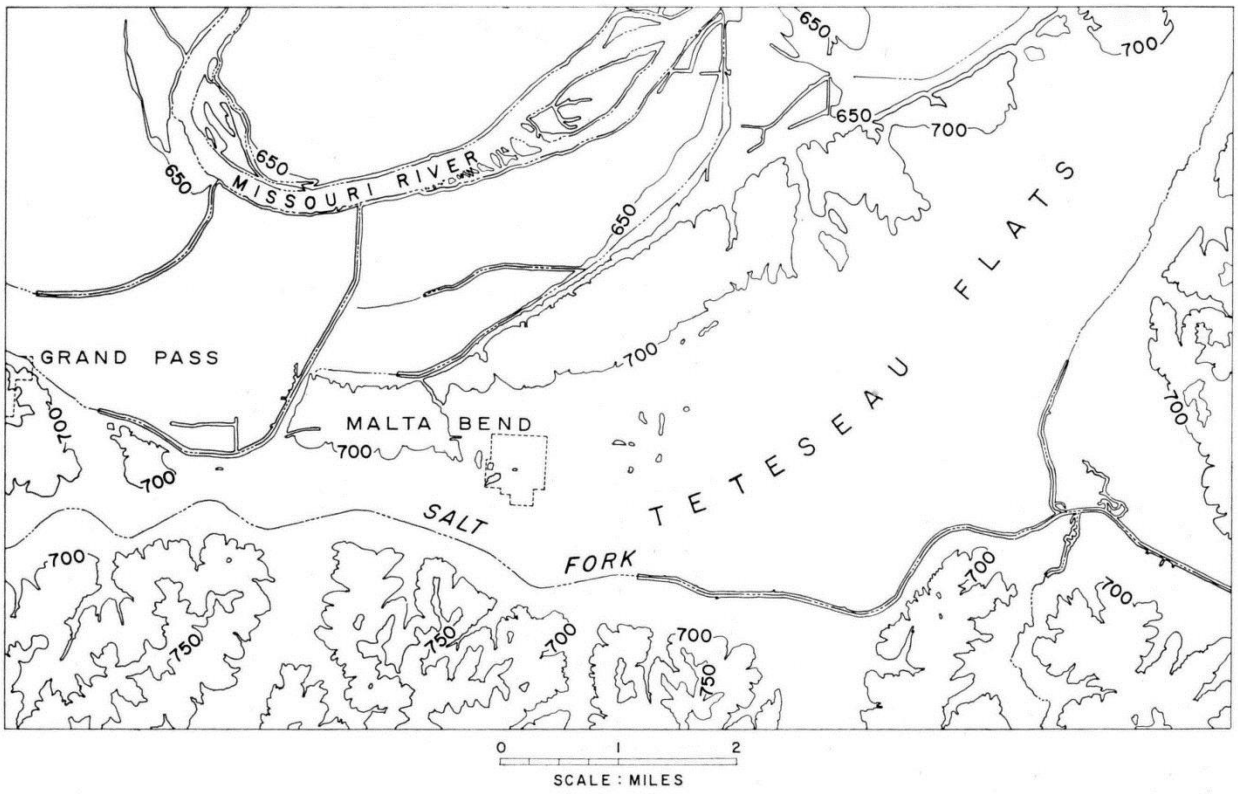
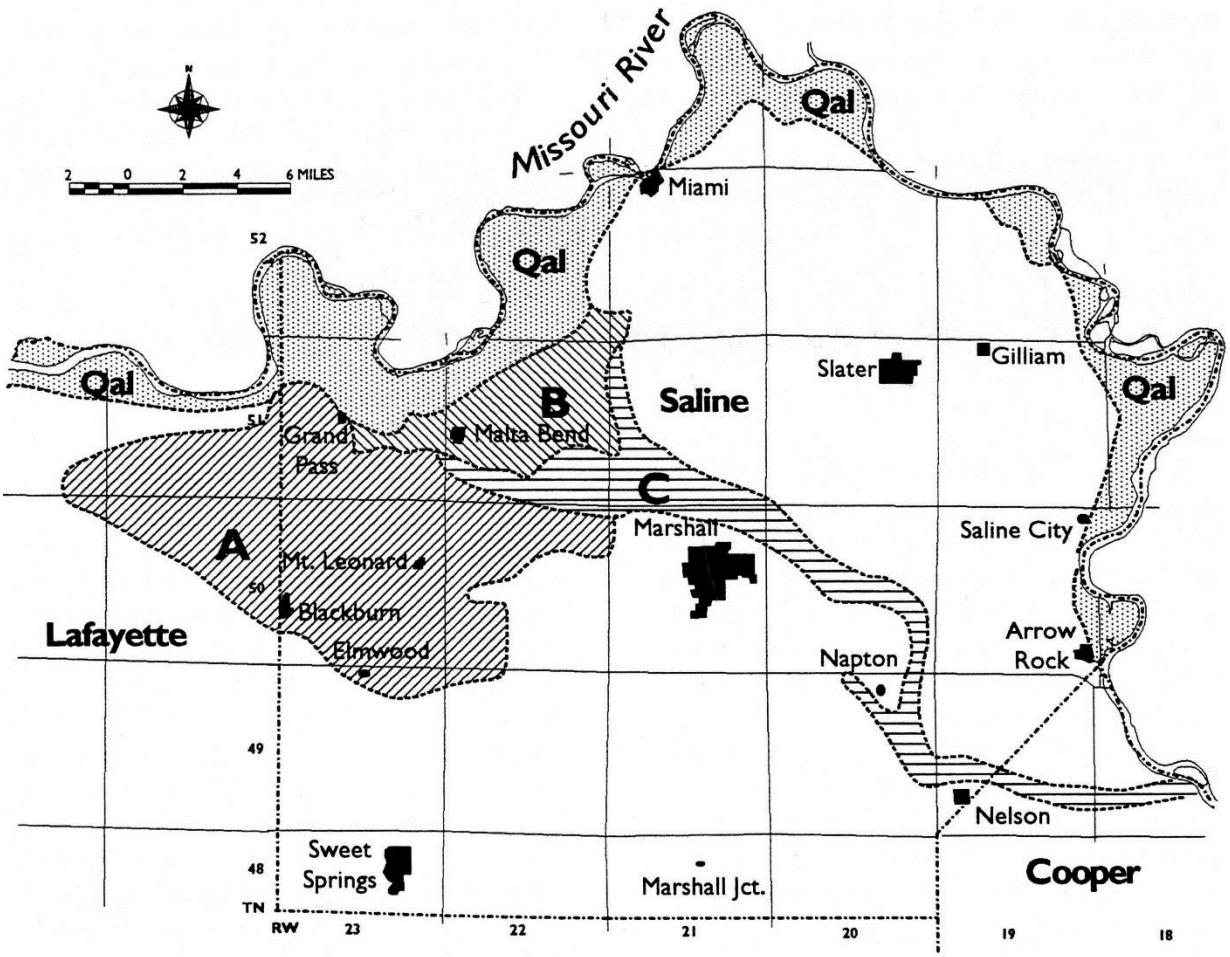


Figure 2: Map of Teteseau Flats (from Bretz, 1965)

John Miller (1971) divided the fluvial deposits from the ice damming event into two units: Teteseau Flats Terrace (area “B” of Figure 3) and a buried glacial stream (area “C” of Figure 3). Miller (1971) describes the buried channel as generally coinciding with the current Salt Fork valley. This abandoned channel is now filled with fine grained sediments with depths that do not exceed 100 feet and is typically covered by loess. Unlike water wells constructed in the Lake City valley that have the ability to produce 300-400 gallons of water per minute (gpm), wells in this abandoned channel only have the capability to produce an average of 50 gpm with a maximum of 100 gpm. Total dissolved solids (TDS) in groundwater produced from this channel ranges from 300 milligrams/liter (mg/L) to 550 mg/L.



LEGEND

Qal — Missouri River Alluvium

Glacial-Fluvial Deposits:

A — Glacial Drift--can exceed 100 ft thick, yields average 5-10 gpm

B — Teteseau Flats--glacial ponded sediments up to 150 ft thick, yields can locally exceed 1000 gpm

C — Buried Glacial Stream Valley--sediments about 100 ft thick, yields range from 20 to about 100 gpm

LOCATION MAP

The

Figure 3: Preglacial valley and the Teteseau Flats area (from Miller and Vandike, 1997)

Teteseau Flats Terrace is a coarse sand and gravel deposit covering an area of 28 square miles and reaching thicknesses of 150 feet (Miller, 1971). Although this deposit is within the Missouri River Valley, it does not qualify as a terrace belonging to the principal river because its drainage flows south-southeast to the Salt Fork, *away from* the Missouri River, with a gradient of 10 feet per mile. The northwest-facing scarp of the Teteseau Flats Terrace is 50 to 60 feet high, reaching an elevation of 720 feet above sea level, and is sharply outlined by the Missouri River floodplain.

Bretz (1965) theorized that this deposit is a result of ice blockage of the Missouri River near Glasgow during the Kansan Glaciation. The Salt Fork valley constricts as one moves from Malta Bend to Marshall and the tributary streams entering this valley are oriented to indicate the ancestor Salt Fork flowed east to west, opposite of its current flow. East of Marshall, the Salt Fork valley opens back up and the tributary streams are oriented to match the west to east flow. This topography indicates the area around Marshall was a surficial high and would have formed a divide that the river needed to cross during the time of the ice blockage. In order for the river to flow over the divide, it would have ponded during the early stages of the blockage and deposited the coarse sand and gravel that now make up the Teteseau Flats alluvial aquifer.

Many of the bedrock aquifers, in the appropriately named Saline County, produce unpotable water with TDS values greater than 1,000 milligrams/Liter. TDS values ranging from 2,000 to 10,000 mg/L are not uncommon for bedrock water. A water sample collected from one well north of Napton had a TDS value of 37,000 mg/L (Figure 4). Shallow wells may produce potable water and have TDS less than 600; however, their yields are generally very low and they typically do not produce enough water for more than domestic usage (Miller, 1971).

Because of the poor quantity and quality of the bedrock water, the Teteseau Flats Aquifer is the source of drinking water for the cities of Marshall and Malta Bend. The highest well yields are associated with the coarser part of this deposit. The city of Marshall has 10 wells producing from this aquifer which also supply water to Malta Bend. These wells can each produce about 1,000 gpm. The water produced from this aquifer has a similar water quality to the buried channel with TDS values ranging from 300 to 500 mg/L (Miller and Vandike, 1997).

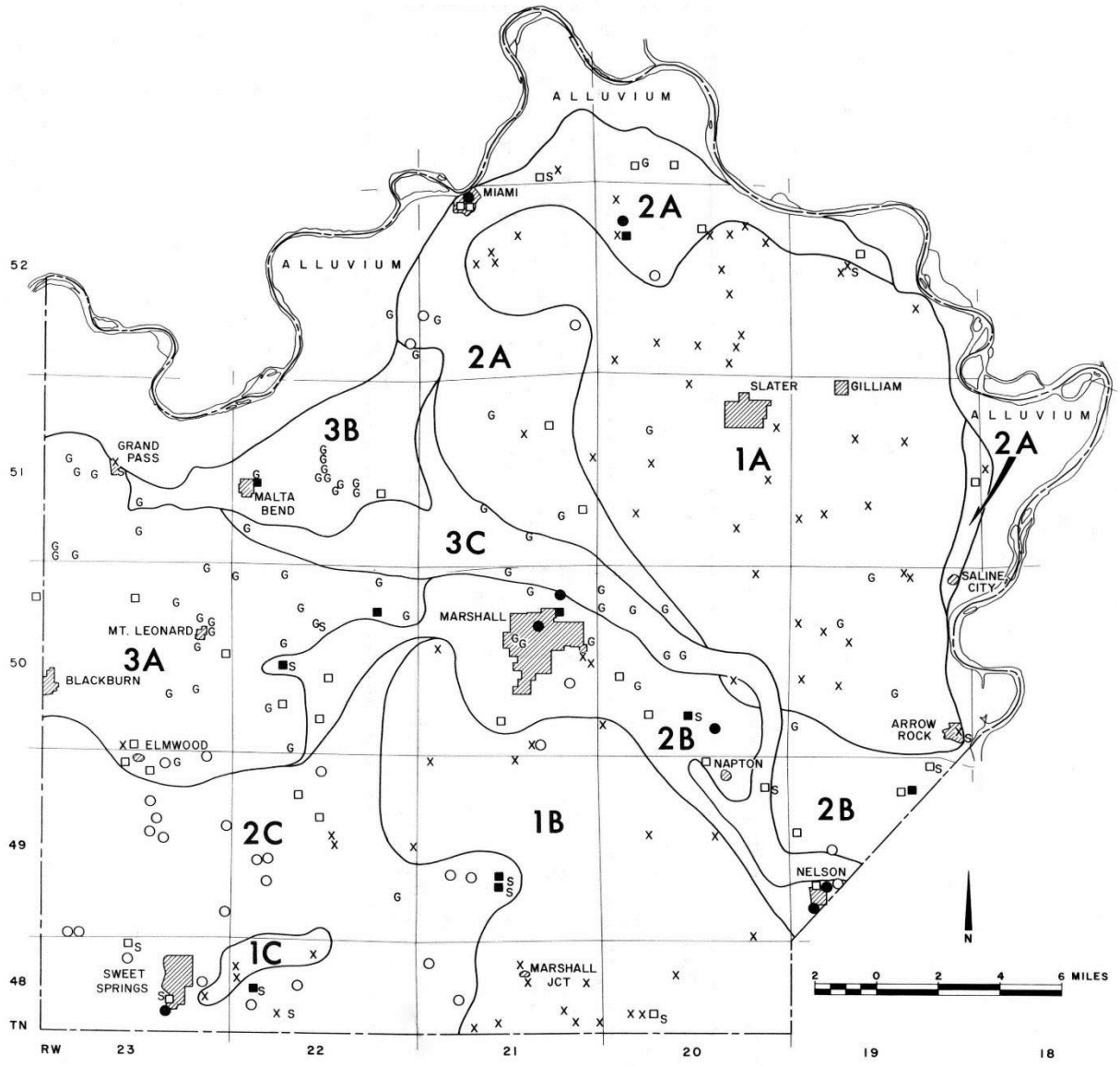
The total volume of high quality groundwater contained in these two deposits in Saline County is estimated to be 170 billion gallons or 521,000 acre-ft (Miller and Vandike, 1997).

References:

Bretz, J. Harlen, 1965, *Geomorphic History of the Ozarks of Missouri*: Missouri Geological Survey and Water Resources, Volume 49, 2nd Serices, 147 p.

Miller, Don E. and Vandike, James E., 1997, *Groundwater Resources of Missouri*: Missouri Department of Natural Resources, Division of Geology and Land Survey, WR-46, 210 p.

Miller, John C., 1971, *Groundwater Resources of Saline County, Missouri*: Missouri Geological Survey and Water Resources, WR-26, 75 p.



GROUNDWATER QUALITY CONTROL POINTS

- x < 1000 ppm TDS
- ○ 1000-1999 ppm TDS
- □ 2000-4999 ppm TDS
- ● 5000-10000 ppm TDS
- ■ 10000 ppm TDS
- S Spring
- G Glacial (well)

1A Burlington to Jefferson City waters: less than 600 ppm TDS. Central portion: best water.

1B Southern portion: less than 500 ppm TDS to Roubidoux. Northern: Cotter less than 600 ppm. Jefferson City greater than 1500 ppm.

1C Unpredictable: salty water after heavy pumping. Cotter 400-1000 ppm TDS

2A TDS 2000-10000 ppm. North: Burlington and Chouteau saline. East: St. Peter saline. Low H_2S

2B TDS depth increase to 37000 ppm in Bonneterre. Wells generally 2000-7000. Lower Burlington saline. H_2S

2C Pennsylvanian cover-high H_2S. 1000-3000 ppm TDS in Burlington to Jefferson City

3A Glacial drift, exceeds 100 ft thickness. 75-350 ppm TDS. Saline water below is extension of area 2C

3B Teteseau Flats - glacial ponded sediments - 150 ft thick. 300-550 ppm TDS. Saline in bedrock

3C Buried glacial stream valley - 100 ft thick. 300-550 ppm TDS. Saline water contamination from bedrock in some areas

Figure 4: Groundwater Quality of Saline County (Miller, 1971)