

CHAPTER 4

GEOGRAPHIC, CLIMATIC ENVIRONMENTAL AND NATURAL RESOURCE PROFILE

GENERAL

The Meramec Region is an eight-county, 5,133-square-mile area, located in the southeast central portion of the state. The smallest county is Maries, with 528 square miles while Washington County, the largest, has 760 square miles. The location of the region in the state is indicated in Figure 4-1. The Meramec Region is bound on the north by Franklin, Warren, Montgomery and Callaway counties; on the west by Miller, Cole, Camden, Laclede, and Texas counties; on the south by Shannon, Reynolds, and Iron counties; and on the east by St. Francois and Jefferson counties. The eight counties of the Meramec Region are Crawford, Dent, Gasconade, Maries, Osage, Phelps, Pulaski and Washington. The region has an average population density of 39.2 persons per square mile. Maries County has the lowest population density with 17.4 people per square mile, while Pulaski has the greatest population density at 95.6 persons per square mile. The size and population density of each county within the region is indicated in Table 4-1. The region's population density is depicted on figure 4-2.

CITIES

There are 35 incorporated places within the Meramec Region, two of which lie partially outside the region. They include: Bourbon, Cuba, Leasburg, Steelville, Sullivan and West Sullivan in Crawford County; Salem in Dent County; Bland, Gasconade, Hermann, Owensville, Morrison and Rosebud in Gasconade County; Belle and Vienna in Maries County; Argyle, Chamois, Freeburg, Linn, Meta and Westphalia in Osage County; Doolittle, Edgar Springs, Newburg, Rolla and St. James in Phelps County; Dixon, St. Robert, Richland, Crocker and Waynesville in Pulaski County; and Caledonia, Irondale, Mineral Point and Potosi in Washington County. The incorporated places of the region are listed by county in Table 4-2.

HISTORY

Crawford County — Crawford County was organized on Jan. 23, 1829, and was named after William H. Crawford of Georgia, who was a candidate for the presidency in 1824. Although the early records of the county court have been lost, it is believed that William Montgomery, Barney Lowe and John Duncan were the first justices of the court, commissioned on the same day the act organizing the county was approved.

The first courthouse, a two-story brick and stone structure, was ordered to be built in 1857 and was used until 1873, when it burned.

The outbreak of the civil war caused considerable excitement in the county, and lines between those favoring the Union and the Confederacy were sharply drawn. A meeting was held at Cuba by some of those favoring the Confederacy at which resolutions were passed in support of the Confederacy. The only dissenting voice at that meeting was that of E.W. Pinnell. Pinnell was the only one of 60 men present at the meeting to later enter the regular service of the Confederate States.

The first settler on the town site of Steelville, the county seat, was William Britton, who arrived in 1833. He was responsible for building a small log house and a grist mill. James Steel, for whom the town was later named, was the next settler in the area. Having purchased 40 acres of land from the government, he sold it to the county court for \$50 in 1835. By this time, he had opened a small store, and a small settlement had sprung up in the area. The deed was recorded in December 1835 and the town was platted and lots sold soon afterward.

Other town sites in the county included Sullivan, Cuba, Leasburg, Bourbon and West Sullivan. Cuba was laid out and surveyed in December 1857 by M.W. Trask and W.H. Ferguson. At the time the town was surveyed, there were no houses within half a mile of the town site.

Leasburg is situated on the Burlington Northern Railroad approximately 82 miles west of St. Louis. The town was originally named Harrison Station for William Harrison. The name was changed in 1859 in honor of Samuel Lea, who built the first residence on the town site. Lea was also the first merchant to open a general store in the area and became the first postmaster.

Bourbon is also situated on the Burlington Northern Railroad about 75 miles west of St. Louis. The town was named for an old post office, which had existed in the vicinity some years before the town was founded. The post office had been named after bourbon whiskey, which was a new product being introduced in the area at that time.

The City of Sullivan is located on Old Highway 66 and the St. Louis and San Francisco Railroad, 68 miles southwest of St. Louis. It has long been known as the "Gateway to the Ozarks." Sullivan was founded in the early 1800's by Stephen Sullivan who, with his wife, accompanied Daniel Boone on his return trip from Kentucky to get settlers to populate the territory around the Meramec River. When the railroad reached the small settlement in 1858, a town was laid out that the railroad company named

“Sullivan.” Only part of the incorporated area of Sullivan lies within the boundaries of the Meramec Region. The balance is in Franklin County.

Dent County — Organized on Feb. 10, 1851, Dent County was named in honor of Lewis Dent, who settled in the county in 1835 and was its first representative, elected in 1862. Dent County was organized from territory once belonging to Crawford and Shannon counties. The first county officers appointed were Justices G.C. Breckinridge, Samuel Hyer Jr. and Jotham Clark, with Joseph Milsaps as sheriff, and David Henderson as clerk.

It was not until 1853 that the present site of the county seat was designated in Salem. Previously the court meetings were held either at the home of Mr. Bressie or Mr. Wingfield near what later became Salem on Spring Creek. Salem was established in 1853, and a brick courthouse erected shortly thereafter. Perhaps when the founders named the town, they had in mind the ancient biblical city of Salem in Canaan, later identified with Jerusalem.

In 1855, the county was disorganized in the state legislature, and three days later reorganized under "An Act to Reorganize the County of Dent," approved on Dec. 4, 1855. In the process of reorganization, some things were done which were not technically legal, and it was found necessary to pass "An Act to Amend an Act Entitled 'An Act to Reorganize the County of Dent.'" The second act declared the proceedings valid and decided on one representative for the county. The county court business proceeded as usual until the Civil War closed operations in 1861, when the last term was held. The courthouse was used as a military headquarters until 1864. In October of that year, while federal troops were away from the area, two Dent County citizens—Simeon Richardson and James Jamison—burned the courthouse and jail. Because of the fire, the court was forced to meet in a store belonging to Judge W.P. Williams, when the court reconvened after the war.

It is uncertain whether remains of mounds, earthworks, pottery and other artifacts found in Dent County were left by the pre-historic people known as Mound Builders or by earlier races of Native Americans. It is known, however, that the Native Americans who roamed the region attributed these artifacts to people who had lived long before their time.

The Native Americans who followed these ancient people in the occupation of Dent County's territory were, it may be supposed, the same as those who wandered over Missouri and the Ozark uplands generally. Early records indicate that they made little trouble for the early settlers in the area. As late as 1838, Native Americans were passing through the county on the White River Trace.

There was no town in the county until Salem was founded as the county seat. The site was chosen by a commission appointed for the purpose of locating the county seat. The town grew to a population of between 600 and 800 people by the opening of the Civil War. After the close of the war, Salem recuperated slowly. The construction of the railway and the opening of the mines during 1872 caused a boom growth. By the time of the panic of 1873, the population had reached approximately 1,100.

Gasconade County — Organized in November 1820, Gasconade County was named for the Gasconade River. Gasconade City was elected as the first seat of the justice for the county. Gasconade City remained the county seat until 1825 when, because of a flood, it was deemed advisable to move the seat to Bartonville. Bartonville was located on the Gasconade River in what is now Osage County and remained the county seat until it, too, was flooded. The county seat was then moved a second time to Mount Sterling, located in a place known as Shockley's Bluff or Starky's Bluff. The county seat remained at Mount Sterling until 1842 when an election was held to determine if the seat should be moved to Hermann. Hermann had promised to render substantial financial assistance to the county if the county seat would be located there. As a result of the election held on March 14, 1842, the county seat moved to Hermann.

The selection of the location for the town site of Hermann was originally made under the auspices of the Deutsche Ansiedlung Gesellschaft (German Settlement Society) of Philadelphia. In March 1837, the society sent a representative through Indiana, Michigan, Illinois, Wisconsin and Missouri to look for a suitable place for a proposed German settlement. By Oct. 5, 1837, the president of the society announced to the membership that a large piece of land had been purchased in Missouri. At the same meeting during which the announcement was made, the society resolved that the name of the new town would be Hermann. Mr. Bayer, who had investigated the town site, was made general agent of the society and agreed to accept the 80 acres of land in the new settlement and a salary of \$600 per year. Every member of the society arriving in the new town was to have the privilege of choosing one lot for himself.

The first storekeeper in Hermann was H.W.D. Wiedersprecher. The railroad was built through the town in 1854, and from that time until the Civil War, the town prospered.

Also located in Gasconade County were the cities of Bland and Owensville. Located in the southwest portion of the county, Bland was named after Congressman R.P. Bland. A trading post was founded near a spring where William Haynes was the first settler in the Bland area in the 1850's. In 1864, General Price's army robbed the stores, took the livestock and destroyed what could not be taken. In 1900, the railroad was being built and the first station was a boxcar. In 1902 a station was built as well as the

Bland Commercial Bank. In 1904, the Bland Courier's first newspaper edition was published and was printed twice weekly with 500 subscribers.

Owensville was laid out in 1886 by the Owensville Improvement Company, consisting of Robert Robyn, Dr. G. Ettmueller, Michael Jordan, Dr. M.W. Hoge and George H. Buschmann. The first three were citizens of Hermann, while the other two founders were from the vicinity of Owensville. The company bought 280 acres of land and platted the town. According to legend, the town was named as a result of a game of horseshoes between store owner Francis Owen and blacksmith Edward Luster, with the understanding that the settlement would be named after the winner. Although Luster won the game, legend has that he decided to name the settlement after Owen because Owensville sounded better than Lusterville. Other Gasconade communities include Morrison, Rosebud and Gasconade.

Maries County—By the beginning of the 1850s, the population of the area now embraced by Maries County had grown large enough that agitation began for the formation of a separate county. A bill for the organization of the county was introduced into the legislature in December 1854 and was approved by the governor on March 2, 1855. The county was named for two streams, the Maries and the Little Maries.

When originally formed, Maries County extended farther south than it does at present, taking in the city of Rolla and barely missing Newburg, both now in Phelps County. This situation persisted only a short time, since Phelps County was formed shortly afterward. Maries County lost some territory to Phelps County, but gained almost as much from Crawford at the same time.

On July 20, 1855, title to the 70 acres of land on which Vienna, the county seat, now stands was acquired from William Shockley. Mr. Shockley donated the tract in consideration of the county seat being located there. The construction of the first courthouse was completed, and the building occupied in October of 1856. The building was completely destroyed by fire on Nov. 6, 1868, and all court records were lost or destroyed. Work on a new building began in 1869 and was completed in 1870. This second courthouse was razed in 1939 to make way for the construction of the present courthouse. The first land entry within the present limits of Maries County was made on Jan. 11, 1826, at which time Charles Lane entered an 80-acre tract. In April of the following year, he entered the adjacent 80 acre tract giving him 160 acres of land known for a hundred years thereafter as the Old Pay Down Mills. Mill sites were in great demand by the early settlers, and Lane probably had such a use for the land in mind when he acquired it.

The trace known as Boone's Lick Road was the site of the first three post offices to be established in the county. The first of these was established on the farm of Lunsford L. Lane in Lane's Ford. Mr. Lane was the postmaster. The second post office, also located on the road, was established in July 1842, in William Hawkins' store and lasted until June 1864. The third post office, located near the crossing of the Boone's Lick and Springfield roads, was established in February 1851 and was located in the home of William Pinnell.

The first school district was organized in Maries County in 1843. Its boundaries were indefinitely described, but it included the northwestern portion of the present Maries County, and the southwestern part of the present Osage County. Davis Woody was the first president of the board of education of the new district.

The first newspaper within the area, 100 miles south of Jefferson City, made its appearance in Vienna on Oct. 20, 1858. It was called the *Central Missourian* and carried the name of C.F. Walker as editor and Henry Lick as publisher. The subscription rate was one dollar per year.

Osage County — The first settlers came into Osage County in the early 1800s and were predominantly French and second-generation Americans from the East. Starting in 1835, there was a large influx of German settlers, which continued for several decades. The county was formally organized in January 1841. It was named for the Osage River. For the first two years after the county's formal organization, county business, to include court business, was conducted in various homes throughout the county. In 1843, the county court requested bids to build a courthouse in the county seat of Linn. Completed in 1844, this building served the county until 1874 when it was sold to make way for a new courthouse. The new courthouse was damaged by fire in 1880, and then burned to the ground in 1922. In 1923, the building, which still serves as the county courthouse, was constructed along Route 50 in Linn.

The early economy of the area was based almost entirely upon agriculture. In 1898, exports from Osage County included cattle, hogs, wheat, corn, flour, sheep, clover seed, wine, poultry, eggs, butter, cross ties, hides and furs. The county is a part of the steep, hilly and rocky Missouri Ozarks and the soil is not conducive to crop production, thus, agriculture has always been strongest in livestock production. Agriculture in the county has always been primarily at the subsistence level. As agriculture became more and more mechanized following WWI, the economic viability of the small subsistence farm dwindled, resulting in great out-migration from the farms. Although the existence of four navigable rivers in or on the borders of the county were historically an asset for transportation of exports and imports, the location of the county prohibits it from becoming a major transportation or trade center.

Phelps County — Phelps County was created by the legislature on November 13, 1857, from territory originally belonging to Crawford, Pulaski and Maries counties. The county was named for John Phelps of Green County, who was governor from 1877 to 1881. The County Seat Locating Commission designated the area now known as Rolla to be the county seat. When the locating commission made its report, considerable protest was voiced concerning the choice of sites. Approximately 600 citizens of the county signed a petition of protest, citing the fact that only two of the three commission members had met to consider the possible sites for the county seat. The matter went first to the Circuit Court and then to the Supreme Court. Before the high court could make a decision, however, the legislature took action on Jan. 14, 1860, confirming the location of the county seat in Rolla. Smarting under a considerable amount of criticism concerning the matter, all members of the county court resigned during April 1858, but later withdrew their resignations.

The town of Rolla did not exist as of Nov. 13, 1857, when the county was created. Only the J. Stever office and John Webber's home were located in the area. Early court business included the location and opening of roads from the county seat to various places within the state, including: St. Louis, Springfield, Jefferson City, Lake Spring and Salem. It is in this last road order, dated in July 1858 that the use of the name Rolla first appears in the court records. The name was used earlier, in May 1858, in a deed of railroad land to the county.

On April 26, 1859, the county court ordered the 50 acres donated by Mr. Bishop for the site of the county seat to be surveyed. The survey was conducted by A.E. Buchanan, a young railroad surveyor. Buchanan delivered his plat to the county court on May 31, 1859.

On Feb. 9, 1861, the day of Rolla's first town council meeting, a county-wide meeting was held to determine whether to join the Confederacy in secession. The consensus at that time was not to take any action until there were further developments. Further developments came in April of that year when Fort Sumpter was fired upon, and county residents decided to support the South. The May 10 Circuit Court session saw a heated debate of secession, which broke up the court. Circuit Court Judge James McBride departed to assume command as a Confederate general under Sterling Price. Outside the courthouse, a group of men drew down the United States Flag and raised a Confederate flag, which had been sewn by the women of Rolla. The group then moved to the newspaper office of Charles Walder, a Union supporter and editor of the *Rolla Express*, and forced him to close his shop. Southern sympathizers patrolled the town day and night, often ordering Union sympathizers to leave town. On June 14 of that year, General Franz Sigel arrived by train with his 3rd Missouri Infantry and took over the town. From that day until the close of the war, Rolla was in Union hands. The 13th Illinois Infantry Regiment, under Colonel John B. Wyman, was brought in to guard Rolla and the Pacific Railroad's terminal. It was this

regiment that did the basic planning and building of Fort Wyman, although other regiments undertook the task of finishing it. President Lincoln's personal order was that Rolla should be held at all costs. Being situated at the terminus of the railroad, military wagon trains went out from Rolla to all Union armies stationed southwest in Arkansas, Hartville and Springfield and northwest to the Linn Creek area, now known as the Lake of the Ozarks. After General Price's defeat at Pea Ridge in March 1862, several troops that were organized by Gov. Jackson returned home. Confederate sympathizers, unwilling to profess their loyalty and support to the Union after the battle, were treated harshly. One example is the shooting of former Presiding Justice Lewis F. Wright and four of his sons in 1864, after being taken from their homes for "questioning."

Other towns within the county included Newburg, incorporated in 1888; St. James, incorporated in 1869; Edgar Springs, incorporated during the 1970s; and Doolittle, incorporated on July 2, 1944. Arlington and Jerome were both incorporated in 1867, but neither is incorporated at this time.

Pulaski County—Pulaski County was organized in 1833. It was named for Revolutionary War General Polish Count Casimir Pulaski. The county was once roamed by Indians and French trappers, and is part of land ceded by the Osage Indians in 1808. Early settlers of the county were southern pioneers, drawn by the springs, woodlands, caves and Gasconade and Big Piney Rivers. The founders of the first settlement were Johnson, Cullen and Duffe, immigrants from Mississippi. They located near the Gasconade River at the "Nitre Cave," about five miles west of Waynesville. These gentlemen found a superior quality saltpeter and began to manufacture gun powder, selling it to trappers and hunters of the area. After the mysterious death of Mr. Cullen, Johnson and Duffe moved upriver to a large spring running into the Gasconade River. They built a large mill, later known as Bartlett Springs Mill.

On December 15, 1818, the Territorial Legislature created Pulaski County. The boundaries were not specified at that time, but were further defined in 1859. The first county court was held at the home of Jesse Ballew. In 1843, the Legislature passed an act to locate the county seat in Waynesville. A crude courthouse was built in early 1844. It was used until 1873, when a brick courthouse was built.

Waynesville was named for the Revolutionary War General "Mad" Anthony Wayne. The town was a stage stop on the St. Louis to Springfield Road, also called the "Old Wire Road," because it was the same route the telegraph traveled. As the Cherokee Indians were removed from Oklahoma in 1837 along the infamous "Trail of Tears," they camped in the area.

The towns of Dixon, Hancock, Crocker, Swedeborg and Richland all came into existence due to the Southern Pacific Railroad. The first railroad ran through south central Pulaski County, but was later abandoned due to rough terrain and routed to its current location.

In 1940, the U.S. Government announced plans to build a military base in Pulaski County. The Army acquired 65,000 acres. Construction began soon after, with an estimated 15,000 construction workers building the camp. The post was named Ft. Leonard Wood, and has since become the largest engineer training center in the U.S.

Washington County — Washington County was organized on Aug. 21, 1813, and was named after George Washington, the first president of the United States. The territory of which the county is composed was previously a part of Saint Genevieve County. Saint Genevieve County was one of the original five districts of which the Territory of Missouri had been composed at the time of its organization in 1812. As it was originally laid out, the county contained more territory than it does at the present time. By subsequent acts of the Legislature, the county had been reduced in size to its present limits.

The commissioners appointed to select a county seat site designated the village of Mine a Breton as the temporary seat of justice for the county. On Feb. 26, 1814, the permanent county seat was established on 40 acres of land donated by Moses Austin and 10 acres of land donated by John Rice Jones. The town was platted with a public square and 22 blocks with 147 lots. The new town was briefly named St. George, but was later renamed Potosi in honor of the Spanish silver mining town in Bolivia. Potosi and Mine a Breton remained separate villages until May 2, 1826, when they were incorporated under the single name of Potosi.

A large courthouse, suitable for a future state capital was planned for Potosi. It was to be financed by the sale of several of the city lots. In the Territorial Convention, Potosi lost in its bid for the site of the capital to Jefferson City and lost by only one vote to St. Charles as the temporary capital until the capitol building could be constructed in Jefferson City. Although Potosi was not successful in becoming the capital of the new state, the State Supreme Court met twice a year in Potosi between 1837 and 1843.

In May 1861, the citizens of Potosi went on record in favor of armed neutrality in the Civil War and organized a home guard to maintain their neutrality. Later that month, Union troops overran the town and arrested several southern sympathizers. In August, Colonel White and a Confederate Cavalry detachment invaded Potosi, but left shortly thereafter. In September 1864, General Shelby and his troops invaded the town, only to be met by a resistance force that had barricaded itself in the courthouse.

The defenders were unsuccessful, and several of them were shot on the courthouse lawn following the engagement. After the Civil War, the surface lead deposits in the area were depleted, and barite mining became prominent.

GEOLOGIC HISTORY

There is a close relationship between the geological history of an area and its present natural resources of soils, minerals, topography and ground water. The quality, quantity and composition of the ground water, soils, minerals and topography are, to an extent, dependent upon historical events. For this reason, an understanding of the geologic past will help explain these features.

The oldest rocks in Missouri include those in Washington County, which were formed in the Precambrian age of geologic history (See Figure 4-3.) At one time, these rocks covered the entire state of Missouri. Ancient streams eroded these rocks to create a large plain, marked by occasional mountains and valleys. Later in geologic history, the entire state was covered by ancient seas into which streams deposited their sediments. This sediment was eventually hardened and became rock. Muds and clays became shale; sand became sandstone; gravel became conglomerate; and the remains of sea organisms contributed to the formation of limestone and dolomite. These sedimentary rocks were stratified, or formed in horizontal layers, the oldest layers at the bottom and the most recently deposited layers at the top. Later in geologic history, many of these sedimentary layers were uplifted by tremendous forces within the earth. The topography of the region is a result of the uneven uplifting or arching of the bedrock and the erosion and weathering of the various types of rocks exposed to the atmosphere.

As a result of the repeated uplifts and eroding, the topography of the region is marked by hills, deep valleys and plateaus. Much of the younger layers of rocks have been eroded away exposing the older rock formation. Springs and caves are common in the carbonate rocks of the region. Springs tend to form where solution has enlarged channels along bedding planes of the layered rocks. If underground channels are large, caves result. Where roofs of caves collapse, sinkholes are formed.

TOPOGRAPHY

Topography in the Meramec Region ranges from broad ridges and gentle slopes to steep slopes bluffs with corresponding variations in elevation. Generally, the topography of the Meramec Region slopes from the Salem Plateau toward the Missouri River. Figures 4-4 through 4-11 illustrate the generalized

topography of each county within the region. The following is a generalized topographic description of each county.

Crawford — Crawford County is divided by a ridge between the Bourbeuse Watershed to the north and the Meramec Watershed to the south. Interstate Highway 44 runs along this ridge. The Bourbeuse Watershed is characterized by gently rolling hills, with only a few steep slopes in the area. Most of Crawford County lies in the Meramec Basin. This area has rugged terrain with steep sloping hills and narrow valleys. The maximum relief in the county is approximately 800 feet, with the lowest point at the northeast corner of the county, and the highest point in the southeast corner.

Dent — Dent County is located principally on a plateau between the Meramec Watershed to the north and the Current River Watershed to the south. The plateau is centered around the City of Salem with a gently rolling topography. To the east of Salem, the terrain becomes more rugged, with steep, sloping hills. The Current River Watershed area is characterized by very rough terrain and extremely steep, sloping valleys. The maximum relief is about 500 feet, with the high point on a ridge south of Salem, and the low points near the north and south borders of the county.

Gasconade — The topography in Gasconade County can be divided into two areas: the area to the south within the Bourbeuse Watershed; and the area to the north, which drains into the Gasconade and Missouri rivers. In the Bourbeuse Watershed, the topography is fairly gentle with rolling hills. North of Highway 28 the topography becomes rough with steep sided valleys and narrow ridges. The maximum relief in the county is approximately 500 feet, with the highest area being at the north edge of the Bourbeuse River Valley, and the lowest at the Missouri River.

Maries — Maries County falls into two major topographic areas. The topography in the eastern portion of the county is typical of the Bourbeuse Watershed, with gently rolling hills and prairie-like terrain. West of the Bourbeuse Watershed the terrain grows rough and hilly. The most rugged terrain is in the western portion of the county in the Maries River Watershed. The maximum relief in the county is approximately 500 feet.

Osage — The topography of Osage County is nearly uniform, consisting of narrow ridges and steep sided valleys. Elevations rise from an average of about 600 feet along the stream valleys to near 1000 feet along the ridge crests. Generally, the land in the county slopes very gradually towards the Osage and Missouri Rivers.

Phelps — The topography in Phelps County east of Rolla is generally rolling hills with steeper hills near the Meramec River. West of Rolla, the terrain is considerably rougher with steep, sloping valleys. In the southern portion of the county, the topography flattens to form a small platform around Edgar Springs. The maximum relief in the county is approximately 500 feet.

Pulaski—Pulaski County is located primarily in the East Osage River Watershed. The basin lies entirely within the Salem Plateau section of the Ozark Plateau. Karst features such as sinkholes, springs and caves are locally prominent within the Salem Plateau. The topography is characterized by steep hills and deep valleys. Headwaters of the Gasconade River are near Waynesville.

Washington — The topography of Washington County is divided by a line coincident with Highway 21. The topography west of Highway 21 is very hilly. The ridges in this area are sharp and the hills are steep sloping. East of Highway 21, the topography is gentle with broad valleys and rounded ridges. The maximum relief in the county is approximately 700 feet.

SOILS

Soil is the thin covering of the earth's surface that is capable of supporting plant life. The physical and chemical properties of soils are due to the integrated effects of climate, parent materials, relief, time and biological activity. Soils are composed of weathered rock materials, mineral, organic matter, water and air in varying proportions.

Where man's activities are associated with land, the nature of soils often influences them either favorably or adversely. Soils determine, in part, the productiveness of the land. Soils and soil material affect the homeowner as well as the engineer in his designs for construction of the many forms of urban development.

Figure 4-12 graphically displays the major soils of the Meramec Region. The map contains limitations relative to its use and the interpretation of the information contained on it. Only a soil map developed by a detailed soil survey can provide the near precise information needed by those persons who desire specific knowledge pertaining to soils and their anticipated behavior under certain uses or conditions. However, in the absence of a detailed soil survey for the Meramec Region, the generalized soil map does provide a graphic description of the general range of soils that exist in the region.

The user must also keep in mind that any particular soil has a range in its characteristics. The data obtained from research in the laboratory and interpretive information developed from such data is based on the central or dominant concept of the range of characteristics of that particular soil. Therefore, the user of soil data presented in this volume should be aware of these limitations, and should use a certain amount of judgment in applying this data in the field.

The following is a generalized description of each of the major soil type associations found in the Meramec Region.

Lebanon - Nixa - Clarksville and Hobson - Clarksville — These are the forested, highly weathered soils that occupy a nearly level to gently rolling topography interspersed with steeply sloping areas bordering drainages and streams. This soil landscape is sometimes referred to as the "Ozark Highland." The soils have developed from cherty dolomite, limestone and sandstone. The nearly level ridgetops show evidence of a thin loess cap less than three feet thick.

The Lebanon soils are positioned on the ridgetops. They are moderately well drained, relatively chert free in the upper three feet and have at depths of 29 to 32 inches a dense impermeable fragipan layer that is underlain by red, cherty clay material. The fragipan limits tree root penetration; hence, only scrub oak strands of timber exist under natural conditions. When cleared, areas of Lebanon are used for pastures and forages, but they are droughty in late summer due to the low water holding capacity of the underlying materials.

The Hobson soils occupy similar positions and have a fragipan, but are developed from sandstone and are even more droughty than the Lebanon.

The Nixa soils have a less distinct fragipan than the Lebanon. They are positioned on more sloping topography and have cherty fragments in and above the fragipan.

The Clarksville soils are positioned on the steeper slopes. They have very cherty light colored surfaces, and red cherty clay subsoils at depths of two feet or more. The Clarksville soils are very droughty.

All of the soils in this association are low in fertility, but there is a potential in this for forage, pasture and woodland, as well as use of the area for recreational purposes.

Clarksville - Fullerton - Talbott — This soil association is the forested limestone-derived soil of the Ozarks that makes up a large part of the landscape along the steeply sloping portions of the Osage,

Gasconade, Meramec, Current and White River drainage basins. The soils differ mainly in chert content and depth to red, high clay subsoils. Clarksville soils are very cherty (stony) in the upper two feet and have red clay subsoils containing less chert than does the surface two feet. Fullerton soils have less chert in the surface and have red clay subsoils at shallower depths. Talbott soils have very little chert and usually have red clay subsoils at less than 10 inches depth. Depth to unweathered limestone or dolomite is variable, but is usually greatest in Clarksville areas, being 15 feet or more. The depth is least in Talbott areas where five feet is common.

All soils have low-to-moderate moisture storage capacities, with Clarksville being the most droughty. Forest and forage production are the main land uses for this soil association, with greatest acreage being in forest. Quality and quantity of production are normally better on the Talbott or Fullerton areas.

It is this soil association along with the spring fed streams in the valleys that gives the Ozarks its unique character. The potential for large forage, forest, wildlife or recreational areas are great.

Union - Fullerton - McGirk — This association of northeastern Ozark border soils is located on rolling to steep topography bordering streams. The soils have formed from thin loess deposited over weathered material from cherty limestones. The area was originally forested, and the soils are light colored.

The Union soils are the most extensive soils in this association. They are moderately well drained and rolling, and have a slight fragipan layer below the subsoil. Because of this fragipan and the underlying materials, the soil has moderately low water storage capacity.

The McGirk soils are gray, poorly drained soils, occupying the foot slopes and other low seepy areas.

The Fullerton soils occupy the steeper slopes. They have light-colored, cherty surfaces and red, cherty clay subsoils. They are well drained, but have limited water storage capacity because of chert content and underlying clay materials.

Other soils are found in bottom lands developed in alluvium. The Lindside soils, for example, are moderately to slowly drained, medium textured and medium in fertility, while the Huntington soils are brown, well drained, fertile and medium textured soils.

The Union and McGirk soils are used for pastures and forages, and the Fullerton soils for woodland and pasture.

Menfro - Winfield - Weldon — These light-colored, formerly forested soils are positioned on the narrow ridgetops and steep slopes in the river hill areas bordering the Missouri River from central Missouri to St. Louis, and in the Mississippi River hills north of St. Louis. The three soils occur in bands or zones, which parallel the river bluff line. The Menfro soils are in a zone on the bluff, and have the steepest slopes. Winfield soils are positioned farther from the river bluffs, and the Weldon soils still farther and on more gently sloping topography.

The silty loessial parent materials are 20 feet or more in thickness near the bluff in the Menfro area, but are 10 to 20 feet thick in Winfield areas and less than 10 feet thick in areas of Weldon. The Menfro soils are well drained and have high available moisture storage capacities. They are fertile and productive, but have severe limitations for agricultural crops because of steep slopes and gully erosion. Tree growth is excellent. The soil is noted for its permeability and its stability when used as road fill or for footings for buildings.

The Winfield soils are not as well drained and are slightly less fertile than Menfro, but they are similar in capabilities and limitations.

Weldon soils are better suited topographically for cultivation, but they are less fertile than either Menfro or Winfield, and are not as well drained, especially in spring months.

Steeper slopes in all areas may have stony soils with most of the stones being limestone or chert.

Ashe-Tilsit-Hagerstown and Tilsit-Hagerstown — Soils of these two associations are restricted to Iron County and adjacent counties where rounded hills underlain by igneous rocks are found with elevations 200 to 400 feet above intervening basins. The basins are underlain by acid sandstone and dolomites.

Ashe soils have formed on the hills or "knobs" from the igneous rocks, which are mainly granites, granite porphyries and felsites. Ashe soils are stony and often have large boulders at the surface. They are acid soils of low fertility and have low moisture storage capacities. Most areas are forested.

Tilsit soils have formed from the acid sandstone associated with the igneous rocks. They have low fertility and only moderate water storage capacities.

Hagerstown soils have formed from dolomites in the basins between the hills of Ashe soils. They are red soils with a low content of stone. They are well drained, but have moderate to high available

moisture storage capacities. They are responsive to soil amendments and are used for forage and grain crops.

The soil landscape, especially that part having both the hills or knobs and basins, has a unique beauty. Lakesites, wildlife and recreational areas are potential uses for much of the Ashe-Tilsit area.

Sarpy-Havnie-Onawa-Wabash — This is an association of alluvial soils found along the Missouri River Valley in northern Gasconade County. Soils of this association are usually composed of soil material eroded from the uplands, which has been deposited by flood waters. The soils are generally moderately clean to sandy clay with a fragipan 18 to 36 inches below the surface and are underlain by sandstone, shale and dolomite.

Sarpy is a light brown soil with a loamy sand subsoil. The soil is rapidly permeable with a moderate amount of surface runoff. The inherent fertility of the Sarpy soil is very high and is used predominantly for forage and cropland. Water storage capacity of this soil is moderate, with some lack of water during the summer period nearly every year.

Havnie is a dark gray brown soil of moderate permeability used mainly for crops. The inherent fertility of this soil is very high and has an excellent water storage capacity.

Onawa and Wabash soils are also used predominantly for crop land because of their high fertility and good to moderate permeability. Water storage capacity of these soils is moderate, being subject to intermittent problems with drought.

CLIMATE

Generalized — Missouri is an inland state, thus its climate is essentially continental. There are frequent changes in the weather both from day to day and from season to season. Missouri is in the path of cold air moving down out of Canada, warm moist air coming up from the Gulf of Mexico and the dry air from the West.

Precipitation — Annual precipitation in the Meramec Region ranges from about 45 inches at Hermann to about 52 inches in parts of Crawford and Washington counties. Snow occurs between November and April, both inclusive, but most of the snow falls in December, January and February. An average of about 16 inches of snow occurs annually in the Meramec Region. It is unusual for snow to stay on the

ground for more than a week or two before it melts. Winter precipitation usually is in the form of rain, snow or both. Conditions sometimes are border line between rain and snow, and in these situations freezing drizzle or freezing rain occurs. Spring, summer and early fall precipitation comes largely in the form of showers or thunderstorms. Thunderstorms are most frequent from April to July. Measurable precipitation occurs on the average of less than 100 days per year. About half of these will be days with thunderstorms.

Most of the precipitation is absorbed by the soil and plants; however, a portion of the precipitation forms runoff and is returned to streams and other bodies of water. Figure 4-13 indicates groundwater yields from bedrock and throughout the region.

Temperature — Because of its inland location, Missouri and the Meramec Region are subject to frequent changes in temperature. The average annual temperature is in the mid 60s with an average in January of about 30 degrees and an average in July of about 78 degrees. A low temperature of -28 degrees has been observed in Salem, and a high temperature of 113 degrees has been observed in Rolla.

While winters are cold and summers are hot, prolonged periods of very hot weather are unusual. Occasional periods of mild, above freezing temperatures are noted almost every winter. Conversely, during the peak of the summer season occasional periods of dry, cool weather break up stretches of hot, humid weather. About half of the days in July and August will have temperatures of 90 degrees or above, but it is not unusual for the temperature to drop into the 50s by the evening. In winter, there is an average of about 100 days with temperatures below 32 degrees. Temperatures below zero are infrequent with only about three days per year reaching this low temperature. The first frost occurs in mid-October, and the last frost occurs about mid-April.

Tornadoes — Tornadoes occur occasionally in Missouri, with an average of only 10 per year for the entire state. About 70 percent occur between March and June with May being the month of most frequent occurrence. Tornadoes occur most frequently in the afternoon between the hours of 4-6 p.m.

HYDROLOGY

WATERSHEDS

Physiographic features, such as watersheds, play an important role in the development of any given area. Practical planning and engineering methods take advantage of the topography in planning and designing

sewer and water facilities. The individual watersheds should form the basis for sewer and water districts, while several contiguous watersheds within the same drainage basin may be combined to form a sewer or water district.

Figure 4-14 outlines the 45 individual watersheds contained wholly or partially within Missouri. A drainage basin is the total area drained by a river and all of its tributaries. Within the Meramec Region, are found the following major water sheds: Lower Osage River Basin, Upper Gasconade River Basin, Big Piney River Basin, Lower Gasconade River Basin, Bourbeuse River Basin, Meramec River Basin, Big River Basin and the Current River Basin.

The Meramec Region is located predominately in three river basins: Gasconade, Meramec and Osage. The Gasconade River and its tributaries including the Big Piney River, Beaver Creek, Little Beaver Creek and Little Piney Creek drain parts of Gasconade, Maries, Phelps and Pulaski counties in the region. Included within this basin are 53 springs: 28 in Phelps County; four in Maries County; two in Gasconade County; and 18 in Pulaski County.

The Meramec River and its tributaries including Bourbeuse River, Dry Creek, Huzzah Creek, Courtois Creek, Hazel Creek, Big River and Mineral Fork drain parts of Maries, Gasconade and Phelps counties and all of Crawford and Washington counties. Included with this basin are 36 springs: three in Phelps County, three in Gasconade County, 23 in Crawford County and seven in Washington County.

The Osage River and its tributaries, including the Maries River, drain parts of Pulaski and Maries counties.

HYDROGEOLOGY

Groundwater yields from bedrock in the Meramec Region is depicted in Figure 4-13. The region is located within the Missouri River Valley and the Ozarks groundwater regions of Missouri. The northern edges of Gasconade and Osage counties are located in the Missouri River Valley. The water table in this river valley is near the surface. The water in this region is hard with a high iron content, but the overall quality of the groundwater is good.

Most of the region is Missippian limestones, Ordovician and Cambrian dolmites and sandstone. Yield is 15-500 gpm, depending on depth and producing formations. Yields locally exceed 1000 gpm in some

areas, including Rolla. Parts of Washington and Dent counties are Cambrian and pre-cambrian rock, yielding 15-50 gpm.

The Ozarks groundwater region has good to excellent groundwater quality. The bedrock aquifers include the Roubidoux Formation, the Gasconade Formation, the Gunter member and the Potosi Formation. The normal and range of well yields for these aquifers is summarized in the following chart:

Aquifer	Normal Yield (Gallons per minute)	Range (Gallons per minute)
Roubidoux	20	10-30
Gasconade	15	10-20
Gunter	40	10-75
Potosi	400	250-600

The Roubidoux Formation is the most reliable shallow aquifer for farm wells in the Ozarks groundwater region. In most of the area, the Potosi is the most reliable aquifer for municipal and industrial water supplies.

ENVIRONMENTALLY SENSITIVE AREAS

The location and characteristics of natural areas need to be considered when adjacent land use activity is to be developed. Environmentally sensitive areas exist in the Meramec Region because of the region's geological characteristics, primarily karst terrain and seismic zones. Figure 4-15 shows these areas.

KARST AREAS

Karst can best be described as a land area lying on soluble rock through which a tangible amount of water moves through naturally occurring cracks and crevices. The most significant natural process occurring in karst areas is the solutional weathering of the soluble rock. This process takes place when rainwater combines with carbon dioxide in the soil or atmosphere and forms a carbonic acid, a weak acidic solution that breaks down limestone. The dissolved limestone washes away leaving cracks and crevices in the rock. These fissures in the stone formation act as conduits from surface water to groundwater.

Because of the porous nature of the underlying rock, a large amount of the rainfall in karst areas moves quickly and directly into the groundwater system. Water moves rapidly through karst and does not undergo the purification it would receive if seeping through soil and less permeable rock formations. Karst area groundwater is very susceptible to contamination, thus making it extremely difficult, if not impossible, to site landfills in karst areas under Subtitle D regulations. The state, when compared to the nation as a whole, is at a distinct disadvantage.

NEW MADRID FAULT AREA

Areas that are susceptible to seismic disturbances also present unique problems. Figure 4-15 shows the major fault lines within Missouri. The New Madrid Fault in southeast Missouri is significant enough to influence solid waste decisions in the Ozark Rivers Solid Waste District. Approximately two-thirds of Crawford and Dent counties and all of Washington County lie within an area this considered a seismic impact zone. There is a 10 percent or greater probability of maximum ground acceleration in hard rock exceeding 1.10 g in 250 years. The map also shows the seismic impact zones within the state with the outermost boundary bisecting Crawford and Dent counties. Washington County is divided between the 10 percent and 20 percent probability zones. The probability percentages increase relative to the proximity to the New Madrid Fault.

ENVIRONMENTALLY SENSITIVE AREAS BY COUNTY

Crawford

Mark Twain National Forest owns 50,053 acres of land in Crawford County. The Mark Twain National Forest includes 13 ranger districts and encompasses 1.5 million acres of Missouri land. The Potosi/Fredericktown Ranger District serves Crawford County.

Summary of Crawford County Public Use Areas and Conservation Areas

County	Area
Crawford	John N. & Melba S. Anderson Memorial Conservation Area Blue Springs Creek Conservation Area Campbell Bridge Access Crawford County (Bird’s Nest Access) Crooked Creek Conservation Area Huzzah Conservation Area

	Keysville Towersite Maramec Spring Fish Hatchery Maramec Spring Park Mint Spring Access Onyx Cave Conservation Area Riverview Access Sappington Bridge Access Scotts Ford Access Sizemore (Pearl G. & John J.) Memorial Conservation Area Woods (Woodson K.) Memorial Conservation Area
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Source: Missouri Department of Conservation Atlas, 2003.

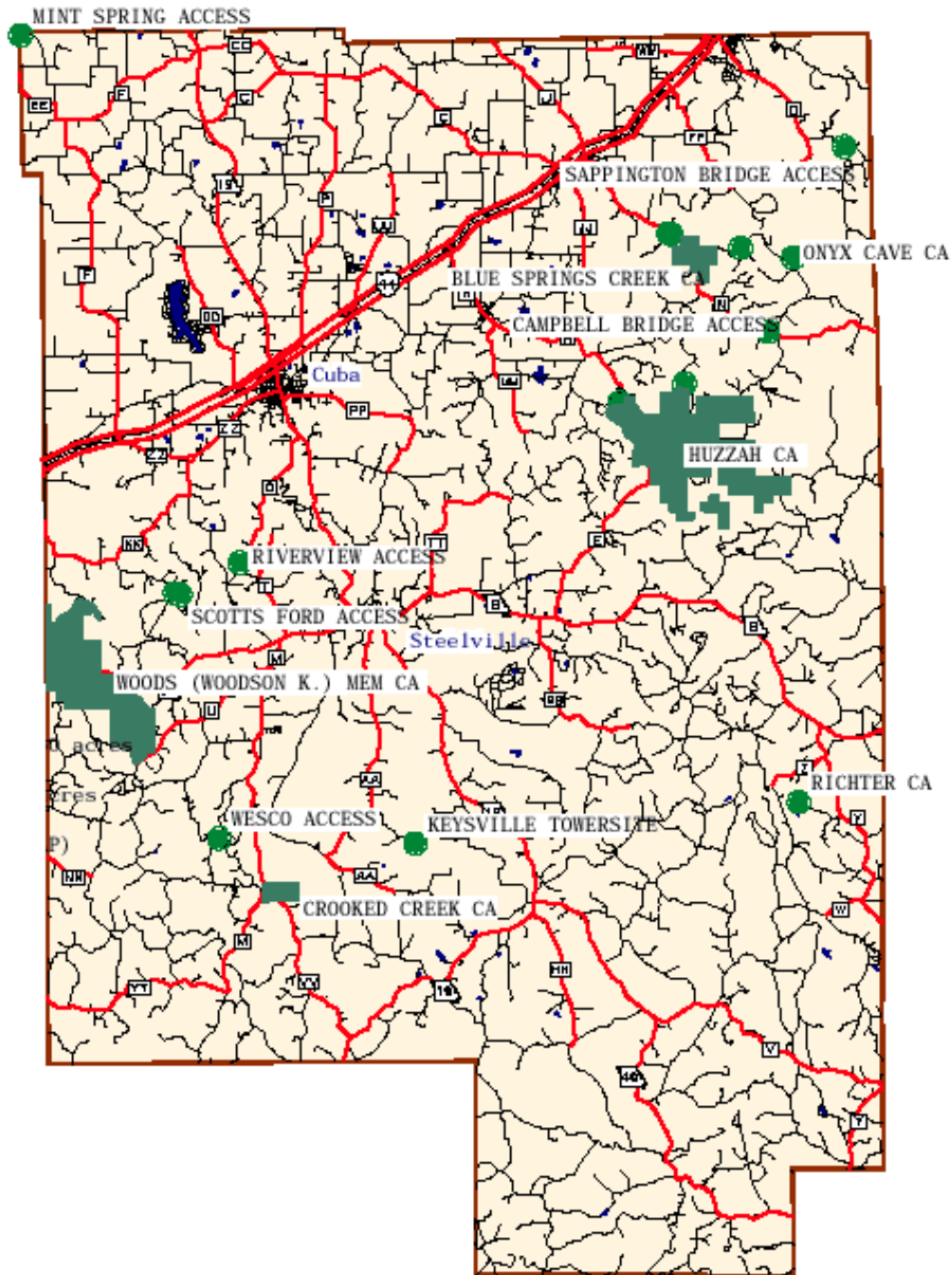
The Mark Twain National Forest contains several recreational opportunities in Crawford County. Trails and wilderness provide adequate opportunity for hiking, biking, horseback riding or ATV/motorcycle. MTNF maintains Red Bluff Recreation Area and Holiday Lake in Crawford County.

The Missouri Department of Natural Resources operates two sites in Crawford County: Onondaga State Park and Dillard Mill State Historic Site. Onondaga State Park is located outside of Leasburg. Onondaga Cave is one of Missouri’s more than 5,500 caves and the state park offers camping, hiking, canoeing and picnic facilities. Dillard Mill State Historic Site is located on Highway 19, south of Steelville. Completed in 1908, Dillard Mill sits along Huzzah Creek and was the second mill built at that site. Today, most of the original machinery is still intact and operational. Picnic sites are available.

The Courtois, Huzzah and Meramec rivers are popular tourist destinations, especially during summer weekends.

Other areas that are considered environmentally sensitive include the water resources located in the county, including the Meramec River basin, and the Bourbeuse River basin.

Missouri Department of Conservation Lands in Crawford County



Source: Missouri Department of Conservation, 2003.

Crawford County is home to a large number of natural springs. Meramec Spring, located in the Meramec River, with an average flow of 93 million gallons per day, is included among the 15 largest springs in Missouri. Twenty-three springs located in Crawford County are significant enough to have

had flow studies done by the Missouri Department of Natural Resources. In the Meramec River basin these include:

- Beaver Spring, 129,000 gpd
- Blue Spring, 3,170,000 gpd
- Blunt Spring, 26,000 gpd
- Collins Spring, 1,030,000 gpd
- Elm Spring, 484,000 gpd
- Ebb and Flow Spring, 13,000 gpd
- Evans Spring, 3,420,000 gpd
- Gibbs Spring, 924,000 gpd
- Indian Spring, 155,000 gpd
- James Spring-1,400,000 gpd
- McDade Spring, 517,000 gpd
- McIntosh Spring, 879,000 gpd
- Onondaga Spring, 1,230,000 gpd
- Richart Spring, 808,000 gpd
- Roaring Spring, 2,650,000 gpd
- Saranac Spring, 833,000 gpd
- Springling Spring, 465,000 gpd
- Steelville Spring, 323,000 gpd
- Unnamed Spring, 1,890,000 gpd
- Unnamed Spring, 2,470,000 gpd
- Camper Spring, 258,000 gpd
- Westover Spring, 8,200,000 gpd
- Woodlock Spring, 1,260,000 gpd

Most of these springs are used for watering stock, but at least one is used for a commercial trout hatchery. Many are unused and most are located on private property. Several springs in the county were once used to power grist mills or to generate electricity for farms or small communities.

The Forest Service lands located in Crawford County are part of the Salem/Potosi Ranger District.

Endangered Species and Species of Concern



According to the Missouri Department of Conservation, several of Missouri's endangered animal and plant species, as well as species of concern, are found in Crawford County. The tiny, white, eyeless Central Missouri cave amphipod lives under rocks or sticks in seven caves and springs in three Missouri counties and nowhere else in the world. This species and other karst species are highly susceptible to poor water quality. Landowners and others work to protect recharge areas that supply water to cave streams and springs. Also of concern are

the Pink Mucket, a thick-shelled freshwater mussel that lives in large rivers in sand and gravel; the Hellbender, a large salamander that lives in streams and rivers; the Cerulean Warbler, a bird that nests in mature hardwood forests in river valleys; the Gray Bat, the Indiana Bat, and the Plains Spotted Skunk.

Dent

Summary of Dent County Public Use Areas and Conservation Areas

County	Area
Dent	Cedar Grove State Forest Richard F. Clement Memorial Forest Hyer Woods Natural Area Indian Trail State Forest Little Scotia Pond Recreation Site Montauk Trout Park White River Trace Wildlife Area Mark Twain National Forest

Gasconade

Summary of Gasconade County Public Use Areas and Conservation Areas

County	Area
Gasconade	Canaan State Forest Gasconade Park Access Helds Island Access Hermann Riverfront Park Fredericksburg Ferry Access Mint Springs Natural Area Tea Access

Source: Missouri Department of Conservation Atlas, 2003

Other areas that are considered environmentally sensitive include the water resources located in the county, including the Gasconade River Basin, Meramec River Basin and the Missouri River Basin.

Gasconade County is home to a number of natural springs. Four springs located in Gasconade County are significant enough to have had flow studies done by the Missouri Department of Natural Resources. In the Meramec River Basin these include:

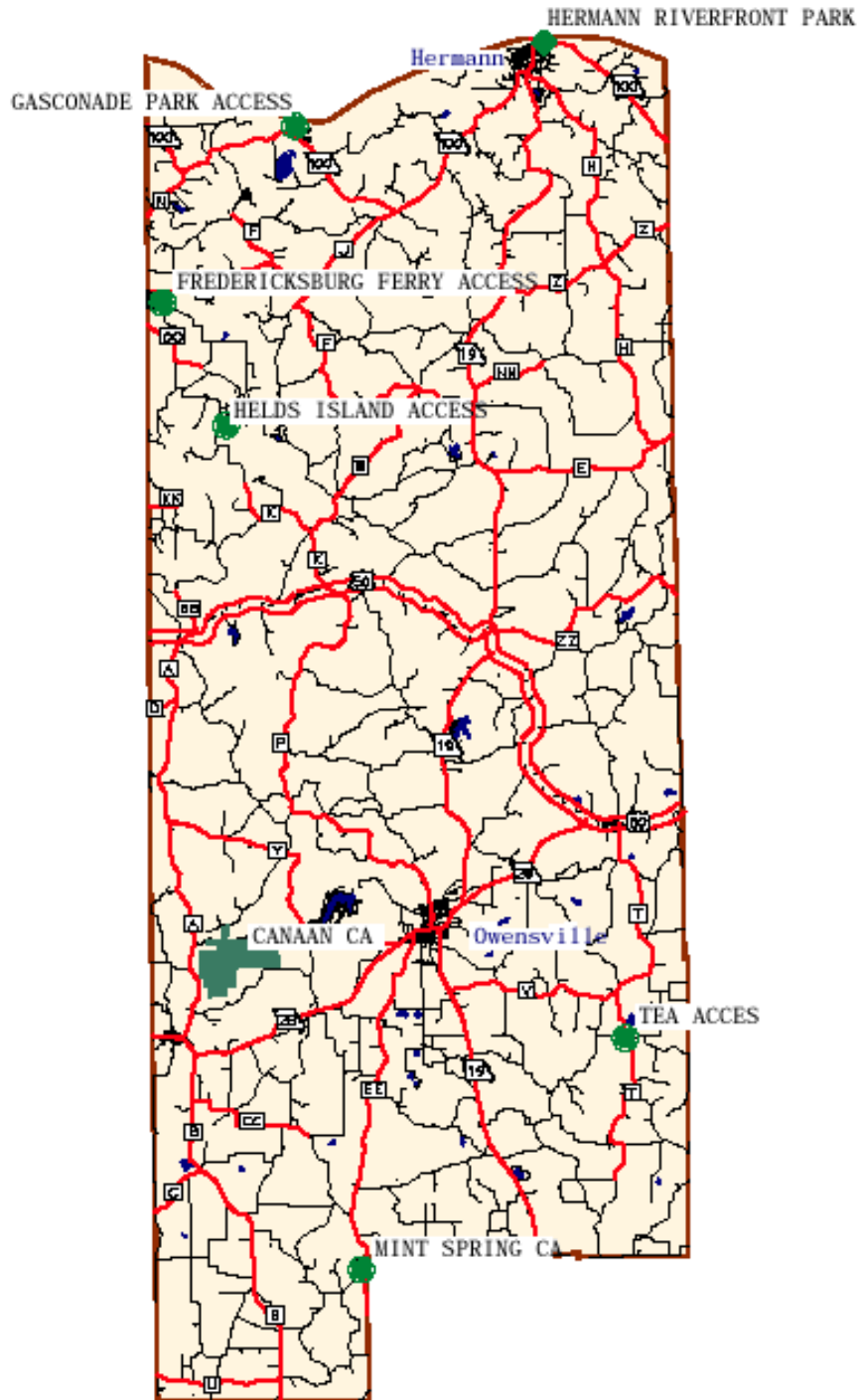
- Coon Cave Spring – 129,000 gpd
- Mint Spring – 6,000 gpd
- Rhodes Spring – less than 0.01 cubic feet per second

In the Gasconade River Basin:

- Williams Spring – 97,000 gpd

Most of these springs are used for watering stock and most are located on private property.

Missouri Department of Conservation Lands in Gasconade County



Source: Missouri Department of Conservation – <http://www.mdc.mo.gov/documents/areas/counties/PHELPS.pdf>

Endangered Species and Species of Concern

According to the Missouri Department of Conservation, several of Missouri’s endangered animal and plant species, as well as species of concern, are found in Gasconade County. The Scaleshell and Pink Mucket mollusks are found in the county’s streams and rivers and the Pallid Sturgeon is found in the Missouri River. The hellbender is a large salamander that lives in clear streams and springs in the Ozarks region. The numbers of this amphibian have declined significantly in recent years



leading to the placement of this animal on the state’s list of species of concern. Birds included on the list are bald eagles and cerulean warblers. Although the bald eagles numbers have increased dramatically in recent years, the cerulean warbler’s population has been in decline. Two bat species are on the federal endangered species list – the gray bat and the Indiana bat. Both populations have declined precipitously and the decline has been attributed to human disturbance, decline of food sources due to pesticides and warming temperatures in hibernation caves. The plains spotted skunk is also listed as a species of concern. This animal’s population has also declined due to habitat loss.

Maries

Summary of Maries County Public Use Areas and Conservation Areas

Summary of Environmentally Sensitive Areas	
County	Area
Maries	Spring Creek Gap State Forest Cliffy Creek Natural History Area Rinquelin Trail Community Lake

Osage

The Missouri Department of Conservation maintains several public use and conservation areas in the county. There are 1,479 acres in Painted Rock Conservation Area, 976 acres in Smoky Waters Conservation Area, 499 acres in Ben Branch Lake Conservation Area, 214 acres in Cooper Hill Conservation Area, 77 acres at Dr. Bernard Bruns Access, 20 acres at Meta Tower Site, 16 acres at Rollins Ferry Access, 9 acres at Pointers Creek Access, 6 acres at Bonnots Mill Access, and one acre at Chamois Access. Figure 2.5 is a map of conservation areas located in Osage County. The Gasconade and Osage rivers are popular recreational destinations, especially during summer weekends.

Summary of Osage County Public Use Areas and Conservation Areas

County	Area
Osage	Ben Branch Lake Conservation Area Bonnots Mill Access Dr. Bernard Bruns Access Chamois Access Cooper Hill Conservation Area Meta Tower Site Painted Rock Conservation Area Pointers Creek Access Rollins Ferry Access Smoky Waters Conservation Area

Source: Missouri Department of Conservation Atlas, 2003.

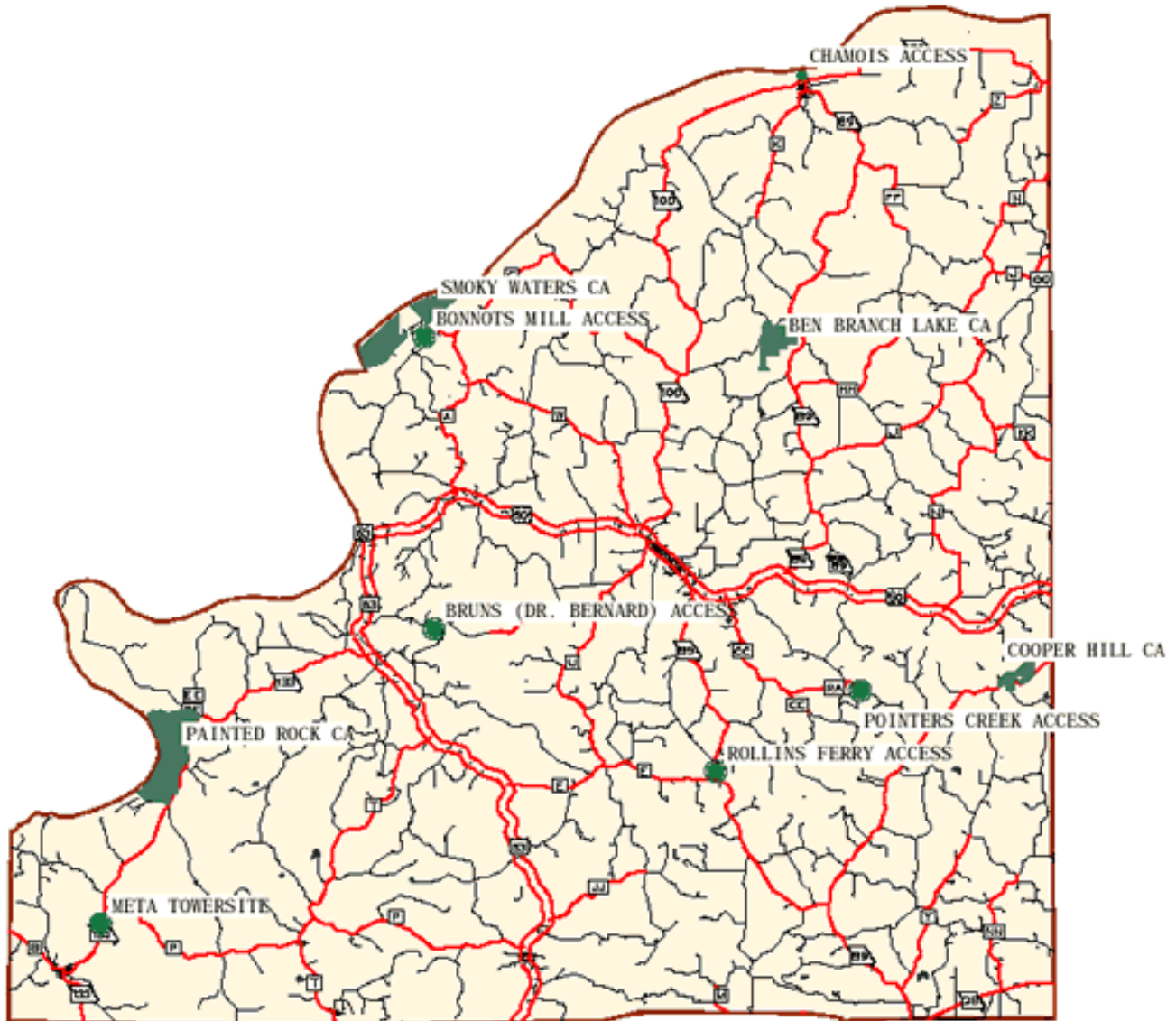
Other areas that are considered environmentally sensitive include the water resources located in the county, including the Gasconade River basin, Maries River Basin, Osage River basin and the Missouri River basin.

Osage County is home to three natural springs that were large enough to have had flow studies done by the Missouri Department of Natural Resources: Bacon Spring, Hollenbeck Spring and Rich Fountain are all located in the Gasconade River Basin.

- Bacon Spring, 32,000 gpd
- Hollenbeck Spring, 90,000 gpd
- Rich Fountain, 26,000 gpd

Most of these springs are used for watering stock and all are located on private property.

Missouri Department of Conservation Lands in Osage County



Source: Missouri Department of Conservation, 2003.

Endangered Species and Species of Concern



According to the Missouri Department of Conservation, several of Missouri's endangered animal and plant species, as well as species of concern, are found in Osage County. The Scaleshell and Pink Mucket mollusks are found in the county's streams and rivers; the Niangua Darter is found in the Osage River and the Pallid Sturgeon is found in the Missouri River. The hellbender is a large salamander that lives in clear streams and springs in the Ozarks region. The numbers of this amphibian

have declined significantly in recent years leading to the placement of this animal on the state’s list of species of concern. Birds included on the list are bald eagles and cerulean warblers. Although the bald eagles numbers have increased dramatically in recent years, the cerulean warbler’s population has been in decline. Two bat species are on the federal endangered species list – the gray bat and the Indiana bat. Both populations have declined precipitously and the decline has been attributed to human disturbance, decline of food sources due to pesticides and warming temperatures in hibernation caves. The plains spotted skunk is also listed as a species of concern. This animal’s population has also declined due to habitat loss.

Phelps

Several of Missouri’s endangered animal and plant species are found in Phelps County. The tiny, white, eyeless Central Missouri cave amphipod lives under rocks or sticks in seven caves and springs in three Missouri counties and nowhere else in the world. This species and other karst species are highly susceptible to poor water quality. Landowners and others work to protect recharge areas that supply water to cave streams and springs. The Missouri glyphopsyche caddisfly is known from only one spring in the Missouri Ozarks, Maramec Spring near St. James, making it a Missouri endemic species. A mishap, such as a chemical spill or some other major disturbance, could wipe out the entire species. Fortunately, the spring is on protected land and seems safe for the time being. Phelps County’s only endangered plant species is the Running Buffalo Clover, which flowers during mid April through June. This plant, which grows in moist, shaded woodlands, historically grew along bison trails, which often followed major streams and rivers. Only three occurrences of the federally endangered running buffalo clover are currently known from Missouri and none are considered secure. The reason for the species decline since the early 1900s is not known, although it seems to have been linked to the earlier extirpation of bison in the state.

National Forest

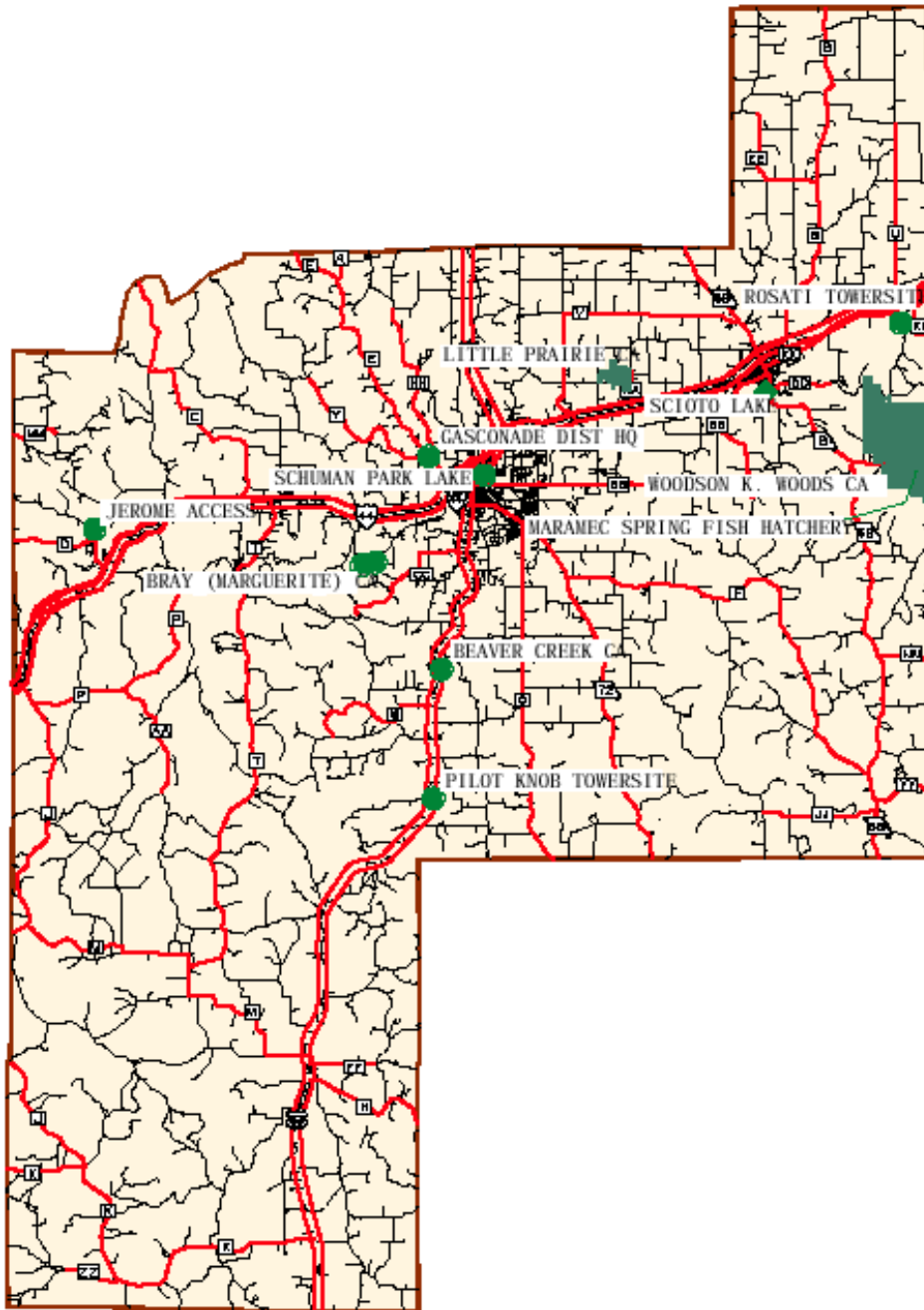
The headquarters for the Mark Twain National Forest is located in Rolla. The forest area includes 13 ranger districts and encompasses 1.5 million acres of Missouri land.

Summary of Phelps County Public Use Areas and Conservation Areas

County	Area
Phelps	Beaver Creek Conservation Area Jerome Access Little Prairie Conservation Area Maramec Spring Fish Hatchery Maramec Spring Trout Park Milldam Hollow Access Pilot Knob Towersite Rosati Towersite Schuman Park Lake Scioto Lake

Source: Missouri Department of Conservation Atlas, 2003.

Missouri Department of Conservation Lands in Phelps County



Source: Missouri Department of Conservation – <http://www.mdc.mo.gov/documents/areas/counties/PHELPS.pdf>

Other areas that are considered environmentally sensitive include the water resources located in the county, including the Gasconade River basin, the Meramec River basin, and the Big Piney River basin.

Phelps County is home to a large number of natural springs. Meramec Spring, located in the Meramec River, with an average flow of 93 million gallons per day, is included among the 15 largest springs in Missouri. Twenty-six springs located in Phelps County are significant enough to have had flow studies done by the Missouri Department of Natural Resources. In the Gasconade River basin these include:

- Arndt Spring-65,000 gpd
- Cold Spring-13,000 gpd
- Coolbrook Spring-129,000 gpd
- Coppedge Spring-12,500,000 gpd
- Cox Spring-13,000 gpd
- Elm Spring-52,000 gpd
- Gollahon Spring-174,000 gpd
- Groover Spring-969,000 gpd
- Lane Spring-11,600,000 gpd
- Martin Spring-840,000 gpd
- Mathis Spring-26,000 gpd
- Mill Creek Camp Spring-13,000 gpd
- Pillman No. 1 Spring-7,490,000 gpd
- Piney Spring-3,230,000 gpd
- Pruett Spring-97,000 gpd
- Roach Spring-116,000 gpd
- Rolufs Spring-155,000 gpd
- Saltpeter Spring-142,000 gpd
- Sugar Tree Spring-1,030,000 gpd
- Yancy Mills Spring-1,000,000 gpd

In the Meramec River basin these springs include:

- Brook Spring-3,030,000 gpd
- Brown Spring-58,000 gpd
- Maramec Spring-93,000,000 gpd

Most of these springs are used for watering stock, but two are used for commercial fish raising. Many are unused and most are located on private property. Coppedge Spring and Yancy Mills Spring were used at one time to power grist and woolen mills; some did so halfway through the twentieth century. Maramec Spring was used in the 1800s to provide water power for a charcoal iron-making industry.

The headquarters for the Mark Twain National Forest is located in Rolla, the largest city in Phelps County. The forest area includes 13 ranger districts and encompasses 1.5 million acres of Missouri land. The Forest Service lands located in Phelps County are part of the Houston/Rolla/Cedar Creek Ranger District.

Endangered Species and Species of Concern

According to the Missouri Department of Conservation, several of Missouri's endangered animal and plant species, as well as species of concern, are found in Phelps County. The tiny, white, eyeless Central

Missouri cave amphipod lives under rocks or sticks in seven caves and springs in three Missouri counties and nowhere else in the world. This species and other karst species are highly susceptible to poor water quality. Landowners and others work to protect recharge areas that supply water to cave streams and springs. The hellbender is a large salamander that lives in clear streams and springs in the Ozarks region. The numbers of this amphibian have declined significantly in recent years leading to the placement of this animal on the state’s list of species of concern. Birds included on the list are bald eagles and cerulean warblers. Although the bald eagles numbers have increased dramatically in recent years, the cerulean warbler’s population has been in decline. Two bat species are on the federal endangered species list – the gray bat and the Indiana bat. Both populations have declined precipitously and the decline has been attributed to human disturbance, decline of food sources due to pesticides and warming temperatures in hibernation caves. The plains spotted skunk is also listed as a species of concern. This animal’s population has also declined due to habitat loss. Phelps County was historically a home to the scaleshell mollusk, which has not been sighted in the county in more than 25 years. This mollusk has been proposed to be added to the federal endangered species list. Phelps County was also once home to the Bush’s poppy mallow, an endangered wildflower that now only survives in five counties in the state of Missouri.



Pulaski

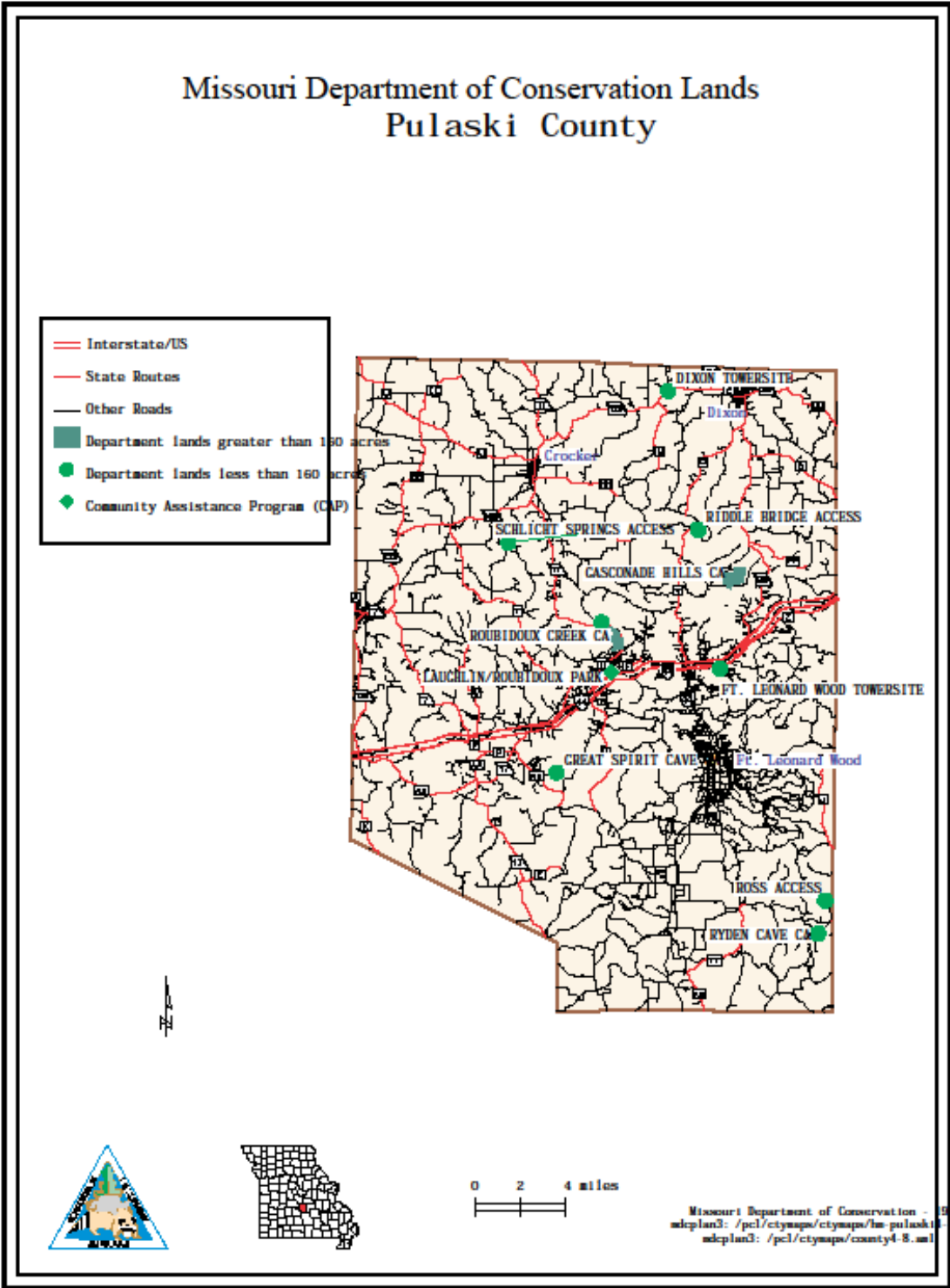
Because of the region’s karst topography and the importance of the tourism industry, there are a number of environmentally sensitive areas in Pulaski County. These areas are classified as sensitive because they are used for outdoor recreation and/or represent a natural feature that is particularly susceptible to damage from pollution or misuse.

Summary of Pulaski County Public Use Areas and Conservation Areas

County	Area
Pulaski	Dixon Towersite Fort Leonard Wood Bloodland Lake Fort Leonard Wood Towersite Gasconade Hills Conservation Area Laughlin/Roubidoux Park (Waynesville) Mark Twain National Forest Mitschele Access Riddle Bridge Access Ross Access Roubidoux Creek Conservation Area Ryden Cave Conservation Area Schlicht Springs Access

Source: Missouri Department of Conservation Atlas, 2003.

Missouri Department of Conservation Lands in Pulaski County



Source: Missouri Department of Conservation – <http://www.mdc.mo.gov/documents/areas/counties/PULASKI.pdf>

Other areas that are considered environmentally sensitive include the water resources located in the county, including the Gasconade River basin and the Big Piney River basin.

Pulaski County is home to a large number of natural springs. Boiling Spring, located in the Gasconade River, with an average flow of 68 million gallons per day, is included among the 15 largest springs in Missouri. Eighteen springs located in Pulaski County are significant enough to have had flow studies done by the Missouri Department of Natural Resources. These include:

- Ozark Spring – 6,000 gpd
- Falling Spring – 1,360,000 gpd
- Land Spring – 116,000 gpd
- Bartlett Mill Spring – 10,100,000 gpd
- Creasy Spring – 15,200,000 gpd
- Schlicht Spring – 594,000 gpd
- Murphy Eddy Spring – 646,000 gpd
- Roubidoux Spring – 37,700,000 gpd
- Miller Spring – 13,600,000 gpd
- Prewett Spring – 11,000,000 gpd
- Stone Mill Spring – 18,700,00 gpd
- Hale Cemetery Spring – 6,000 gpd
- Shanghai Spring – 11,600,000 gpd
- Harrison Spring – 3,880,000 gpd
- Mossy Spring – 775,000 gpd
- Pruet Spring – 969,000 gpd
- Pillman Spring #1 – 7,490,000 gpd
- Boiling Spring – 68,000,000 gpd

Most of these springs are used for watering stock, but two are used for commercial fishing. Many are unused and most are located on private property. At least six of these springs were used at one time to power grist and woolen mills, some did so halfway through the twentieth century. Miller Spring is the largest known ebb-and-flow spring in the state and the only one known to exist in the Gasconade River basin.

The headquarters for the Mark Twain National Forest is located in Rolla, in neighboring Phelps County. The forest area includes 13 ranger districts and encompasses 1.5 million acres of Missouri land. The Forest Service lands located in Pulaski County are part of the Houston/Rolla/Cedar Creek Ranger District.

Endangered Species and Species of Concern

According to the Missouri Department of Conservation, several of Missouri's endangered animal and plant species, as well as species of concern, are found in Pulaski County. The tiny, white, eyeless Central Missouri cave amphipod lives under rocks or sticks in seven caves and springs in three Missouri counties and nowhere else in the world. This species and other karst species are highly susceptible to poor water quality. Landowners and others work to protect recharge areas that supply water to cave

streams and springs. The hellbender is a large salamander that lives in clear streams and springs in the Ozarks region. The numbers of this amphibian have declined significantly in recent years leading to the placement of this animal on the state's list of species of concern. Birds included on the list are bald eagles and cerulean warblers. Although the bald eagles numbers have increased dramatically in recent years, the cerulean warbler's population has been in decline. Two bat species are on the federal



endangered species list – the gray bat and the Indiana bat. Both populations have declined precipitously and the decline has been attributed to human disturbance, decline of food sources due to pesticides and warming temperatures in hibernation caves. The plains spotted skunk is also listed as a species of concern. This animal's population has also declined due to habitat loss. Pulaski County was historically a home to the scaleshell mollusk, which has not been sighted in the county in more than 25 years. This mollusk has been proposed to be added to the federal endangered species list. Pulaski County was also once home to the Bush's poppy mallow, an endangered wildflower that now only survives in five counties in the state of Missouri.

Washington

Mark Twain National Forest owns several acres of land in Washington County. The Mark Twain National Forest includes 13 ranger districts and encompasses 1.5 million acres of Missouri land. The Potosi/Fredericktown Ranger District serves Washington County.

The Mark Twain National Forest contains several recreational opportunities in Washington County. Trails and wilderness provide adequate opportunity for hiking, biking, horseback riding or ATV/motorcycle. MTNF maintains Berryman Recreation Area, Council Bluff Recreation Area and Brazil Creek Area in Washington County.

State Parks

Nestled in the forest lands of the eastern Ozarks, Washington State Park once was a ceremonial ground for prehistoric Indians. Today, the petroglyphs-rock carvings that are remnants of the Indian culture-are a special attraction. The 1,855-acre park has a modern swimming pool, and Big River, which borders the park, provides opportunities for canoeing and fishing. Kitchen-equipped rental cabins, a camper store, canoe rentals and shaded campsites are available in the park.

A 68-acre portion of Washington State Park can be accessed by the Thousand Steps Trail, which begins along the road east of the dining lodge. It features a mesic limestone forest located in the Mississippi River Section of the Ozark Border Natural Division; the hardwood forest has developed over broken down talus at the base of a dolomite bluff. Dominant trees include northern red oak, chinquapin oak, white oak and Kentucky coffee tree with many of the overstory trees older than 150 years. The area is noted for its luxuriant and diverse spring wildflowers.

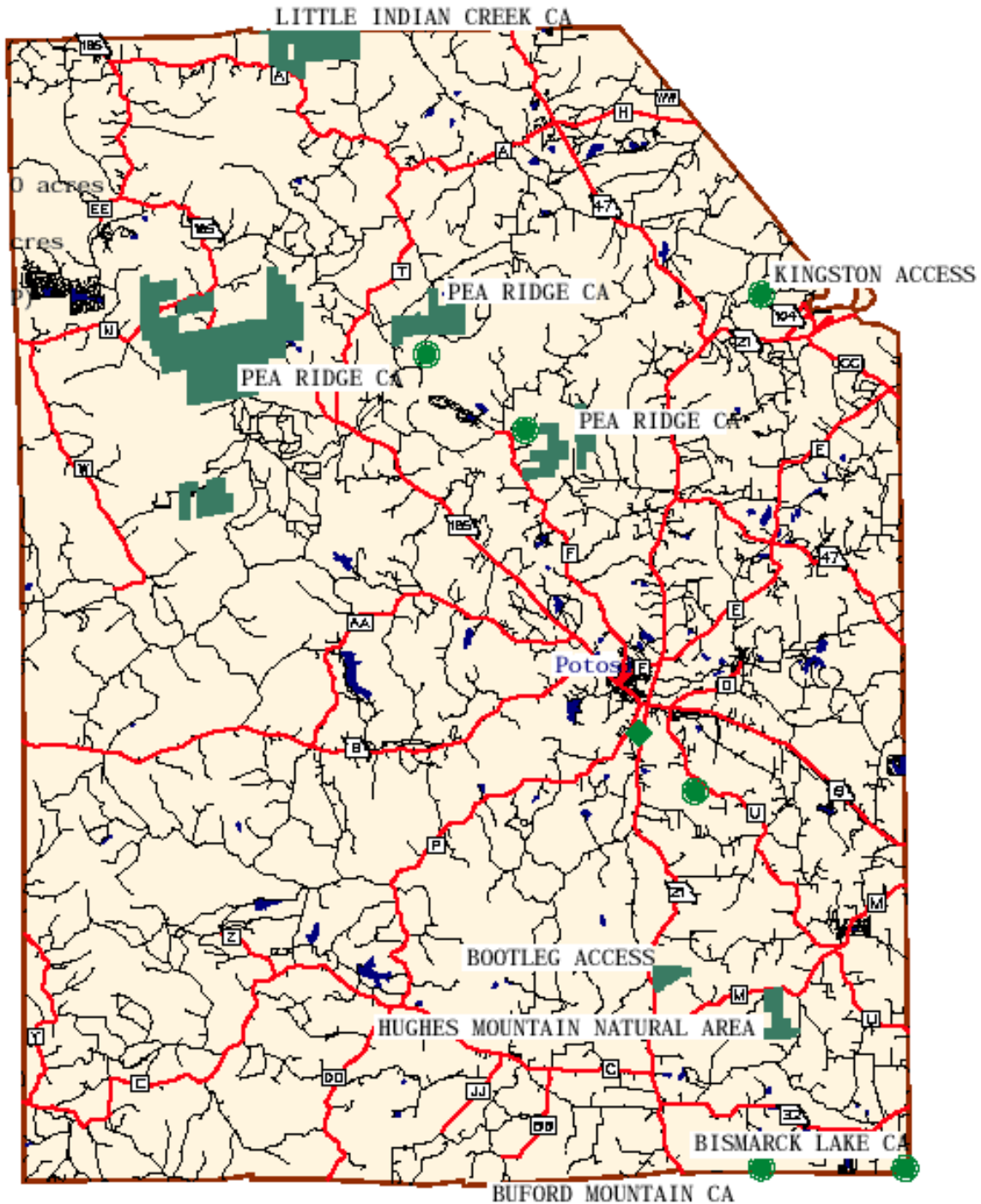
Summary of Public Use Areas and Conservation Areas

County	Area
Washington	Bismarck Conservation Area Bootleg Access Buford Mountain Conservation Area Hughes Mountain Natural Area Kingston Access Little Indian Creek Conservation Area Mark Twain National Forest Pea Ridge Conservation Area Potosi (Roger Bilderback Lake) Washington State Park

Source: Missouri Department of Conservation Atlas, 2003, and Missouri Department of Natural Resources

The Courtois and Big rivers are popular tourist destinations, especially during summer weekends. Washington County is located in three river basins: Big, Upper St. Francis and Meramec. The Meramec River includes the following tributaries: Bourbeuse River, Dry Creek, Huzzah Creek, Courtois Creek, Hazel Creek, Big River and Mineral Fork. Included with this basin are 36 springs—seven in Washington County.

Missouri Department of Conservation Lands in Washington County



Source: Missouri Department of Conservation, 2003.

Big River

The Big River basin is located in east-central Missouri and drains 955 square miles of the Ozark Plateau in parts of six counties. The river has eight tributaries and flows northward for 138 miles until it reaches the Meramec River. The majority of land use is forest and pasture with some row cropping along stream

bottoms. However, urbanization is rapidly increasing in the lower basin. Only one public water supply withdrawal uses significant amounts (0.75 million gallons/day) of basin surface water. Additionally, 10 wells with a maximum pumping capacity of 24.5 million gallons/day operate within the basin.

Only five percent of the basin is owned by state and federal agencies. Basin streams exhibit typical Ozarkian characteristics: good water quality and fish habitat. Nineteen sensitive natural communities, including good examples of Ozark creeks and Ozark springs and spring branches are present. However, damage to some aquatic habitats and the potential for serious damage to several streams exists due to past lead and barite mining activity. Stabilization and reclamation projects are beginning to address some of these problems. Unsafe mine dams and poorly-stored mine waste continue to degrade habitat or biota in about 110 miles of basin streams. The United States Army Corps of Engineers predicts catastrophic results from 27 high-hazard, unsafe dams during a moderate earthquake or major flood.

Riparian corridors are negatively affected by riparian land use, especially along tributary streams. Overall, stream habitat is good with rockslides, boulders, gravel, water willow, downed logs, and rootwads. A fish consumption advisory for some fish species is present on Big River due to lead contamination. The basin exhibits good aquatic biodiversity. One hundred fish species, 34 mussel species, eight crayfish species, and 107 aquatic insect taxa have been found within the basin. Four fish and three mussel species are either endangered, rare, or on the State watch list.

The riparian corridor condition is fair to poor. Generally, Big River's corridors were in better condition than its tributaries. Sixty percent of Big River sites exhibited a timbered stream corridor greater than 75 ft., versus 44 percent for tributary stream sites. Row cropping and hay production took place near Big River, but generally comprised a smaller portion of the riparian corridor. Corridor width is being reduced along streams with increasing amounts of urbanization.

The basin contains 102 point sources of pollution, including five storm water sources from landfills and quarries, and 16 mining sources. Approximately, eight miles of the basin streams are affected by municipal sewage facilities, primarily from lagoons. The Big River basin receives non-point source pollution from 65 sites, mainly runoff from poultry farms and mines. Mining is responsible for 98 percent of the basin's non-point source pollution.

Endangered Species and Species of Concern

Washington County is home to some of Missouri's endangered species. The migratory Gray and Indiana bats are cave dwellers that typically thrive in caves and old mines. Gray bats can fly up to 60 miles an hour and only weigh six to nine grams; however pesticides and human disruption are threatening their lives. Indiana bats are similar in size and dwell in caves, but migrate north in the summer. Both bats depend heavily on cave life and the threat to losing them also threatens the life of other cave-dwelling animals. Another cave-dwelling endangered species is the Central Missouri cave amphipod. The crustacean lives under rocks and sticks in caves and springs and can be found nowhere else in the world. Polluted waters are threatening the small, shrimp-like animal and are putting it alarmingly close to extinction. The last endangered species in Washington County is the Cerulean Warbler, a small, insect-eating bird. Logging and deforestation have made the birds susceptible to harm due to their need of unbroken, mature forests. The destruction of their breeding habitats is quickly bringing the destruction of the species.

According to the Missouri Department of Conservation, the American burying beetle, the largest carrion beetle of its kind in North America is found in Washington County and is considered rare and threatened.

Gray Bat



Photo by Adam Mann, Environmental Solutions and Innovations

Indiana Bat



Jim Rathert

Cerulean Warbler



Photo by Stuart Tingley

Central Missouri Cave Amphipod



Gene Gardner

AGRICULTURE

GENERAL

The number of farms in the Meramec Region is decreasing. From 1997-2007, the number of farms in the region has decreased from 6,625 to 6,141—a drop of 484 farms. This represents a 7 percent decrease. During that same timeframe, acreage in farmland also decreased by over 124,000 acres. This is considerably higher than state trends, which show a loss of about 3 percent of farms and 4 percent of farmland from 1997-2007. Two counties in the region showed an increase in the number of farms from 1997 to 2007—Gasconade and Maries counties. Dent County had the largest decrease with 170 fewer farms, followed by Pulaski County with a decrease of 133 farms. Details on the number of farms and the percentage of change from 1997 to 2007 are found on Table 4-3.

SIZE

Table 4-3 also provides data on the average size of farms in acres in the region. The average size of farms in the Meramec Region—at 253 acres—is back down to the average size in 1997, after increasing by about 9 acres from 1997 to 2002. Crawford County farms tend to be a bit larger than those of the other counties, at 275 acres, average. Phelps County farms are the smallest, with an average of 213 acres.

The region has about 470,000 acres of cropland, with a little over 300,000 acres harvested. Total woodland for the region is around 280,000 acres and pastureland is at 500,000 acres.

FORESTRY

GENERAL

The Ozarks region of Missouri is the focal point of several converging ranges of plant associations. Eastern hardwoods, southern pines and western prairies and the wildlife each supports, all reach the outward limits of their range in this area. As a result, various types of forest lands and animal habitats co-exist within a limited area

PHYSIOGRAPHY

Topography ranges from broad ridges and gentle slopes to steep slopes and bluffs with corresponding variations in elevation. For the most part, the soils of the forest areas are formed on the cherty dolomite and sandstone residuum derived from the Jefferson City and Roubidoux geological formations. The soils are generally droughty and somewhat low in inherent fertility. Droughtiness is due primarily to high chert content, extensive subsurface drainage, and shallow fragipans.

The climate is characterized by a range of temperatures with extremes occurring only occasionally. The frost-free period extends from about April 20 through October 15, and the growing season averages 180 days. Precipitation, most of which is rainfall, averages 42 inches per year. About 30 inches of that average occurs during the spring months. Heavy rains result in excess run-off with occasional flash floods. Sleet and glaze storms occur annually and result in damage to timber. Tornadoes occur at infrequent intervals. Droughts of short duration occur annually during the late summer months, while more severe droughts occur infrequently.

Permeable soils with subterranean drainage, lack of sufficient rainfall during the growing season, and high evapo-transpiration rates during the summer months affect the volume of growing stock that can be managed on forest lands. Soil moisture depletion occurs early in the growing season during normal years, causing moisture to be a limiting factor of native tree species in the Meramec Region.

DEFINITIONS

The following are definitions of terms used in the text and tables of this chapter.

All live – All trees greater than 1.0 inch in diameter.

Commercial Forest Land - Forest land that is producing, or capable of producing crops of industrial wood, and has not been withdrawn from timber utilization by statute or administration regulation.

Forest Land - Includes areas of at least 10 percent stocked with trees capable of producing timber or other wood products, as well as land from which trees have been removed, so long as the land has not been developed for other purposes.

Forest Type - Classification by forest type is based on the species forming a plurality of stocking based on gross cubic volume of timber. Non-stocked forest land is classified with the forest type best suited to the soil.

Growing stock trees – Live trees of commercial species that are 5.0 inches or larger that meet (now or in the future) regional merchantability requirements in terms of sawlog length grade and cull deductions. It excludes rough and rotten trees.

Non-commercial Forest Land - Forest land which otherwise qualifies as commercial forest which has been withdrawn from utilization by statute, ordinance, or administrative order, or forest land incapable of yielding a stand averaging at least one 13 foot saw log per tree.

Non-stocked - Areas failing to meet any of the preceding criteria except that for commercial forest land.

Poletimber - Stands failing to meet specifications for sawtimber, but at least 10 percent stocked with trees of five inches in diameter at breast height (D.B.H.) or larger and having at least half of the minimum stocking in poletimber - size trees.

Sawtimber – Any commercial tree species greater than 11 inches.

Seeding and Sapling - Stands failing to meet requirements as either sawtimber or poletimber, but at least 10 percent stocked with trees of commercial species, and at least 5 percent stocked with seedlings and saplings.

Timberland – Forestland that is capable of growing at least 20 cubic feet of wood per acre per year.

FOREST AREA

As shown on Table 4-4, in 2007 there were 2,498,067,746 cubic feet of all live trees on timberland, according to the 2012 US Forest Service Forest Inventory. Washington County had the largest amount of all live trees on timberland in the area, 385,723,053 cubic feet. Maries is on the low end of the scale with 139,425,231 cubic feet of all live trees on timberland.

According to Table 4-5, the region had 2,116,022,991 cubic feet of growing-stock on timberland (87 percent hardwoods). About 90 percent of the live trees on timberland were growing stock. Annual growth of the growing-stock (Table 4-8) averages about 49 million cubic feet. An average of 16,662,131 cubic feet of growing stock is lost annually (Table 4-6).

NATIONAL FOREST

The headquarters for the Mark Twain National Forest is located in Rolla. The forest area includes 13 ranger districts. The responsibilities of the National Forest include the following:

1. Coordinate timber management activities with the use of other resources.
2. Achieve a better balance of size classes throughout the forest, based on a rotation period of 80 years for pine and 90 years for hardwood.
3. Market the programmed annual cut and promote the marketing of the allowable cut.
4. Assist industries, communities, and area development agencies to expand wood using industries.
5. Assure adequate stocking of all regeneration areas.

MINERAL RESOURCES

The mineral resources of the region have been an important factor in the local economy, but several problems face the mining industry. The location of mining areas presents problems in the removal of mining wastes, pollution of local water supplies and the reduction in the market for mineral resources in the region. This chapter will give a summary of the mining industry in the region and the impact on the economy. It will not be as complete as one would like since it has become extremely difficult to acquire data from the mining industry. Some data and information will be included from previous planning documents to provide an overall view of the resources and their location.

Table 4-9 lists the mining and quarry companies and their location. Figure 4-16 shows where the different mineral resources are located in Missouri. Resources in the region include fire clay, crushed stone, construction sand and gravel, dimension sandstone, perlite, iron oxide pigments, and iron. Mineral resources close to the region include silver, copper, lead and zinc. Mining/quarry industries are discussed in Chapter 7: Economy.

Figure 4-1: Meramec Region

Meramec Region

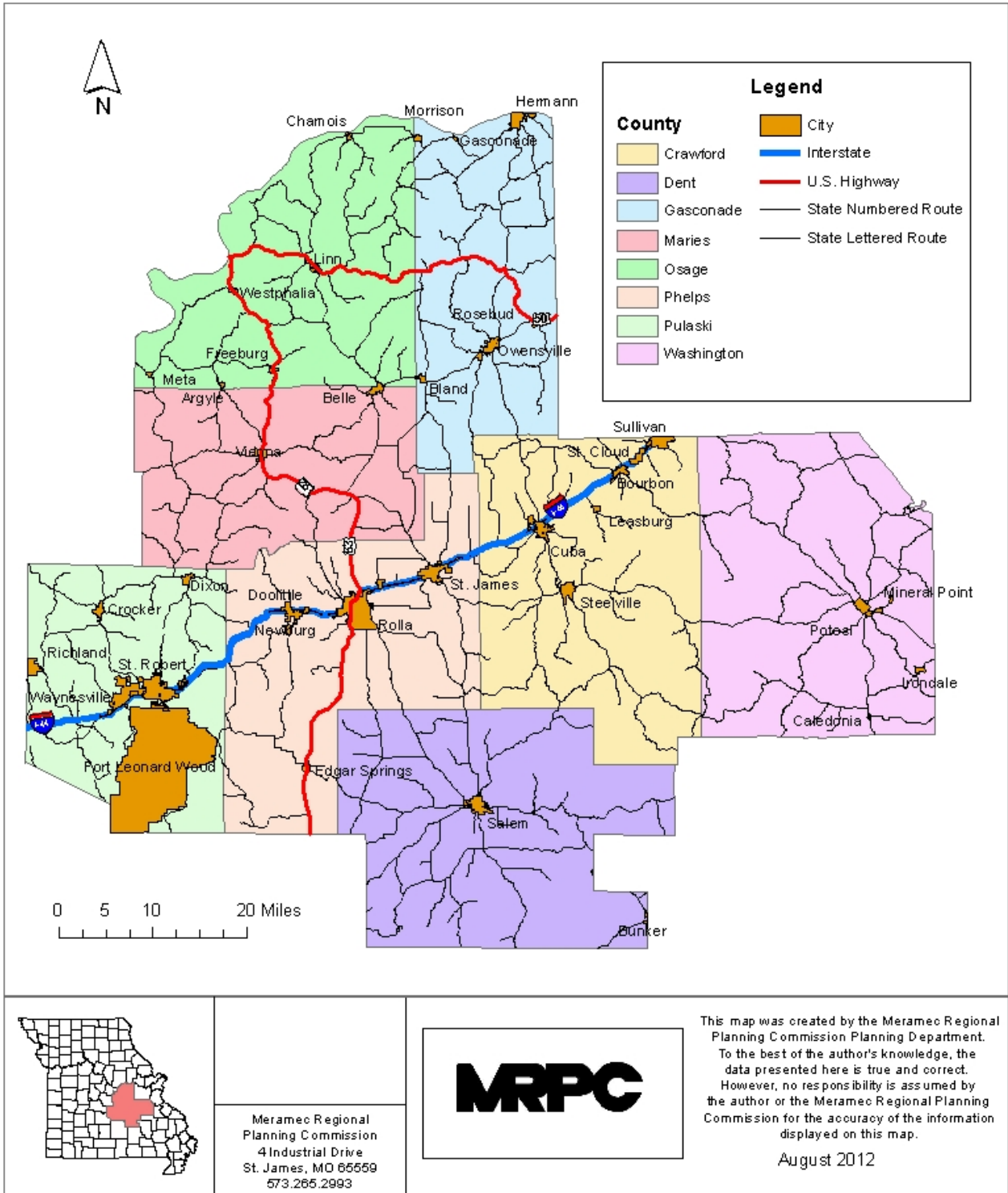
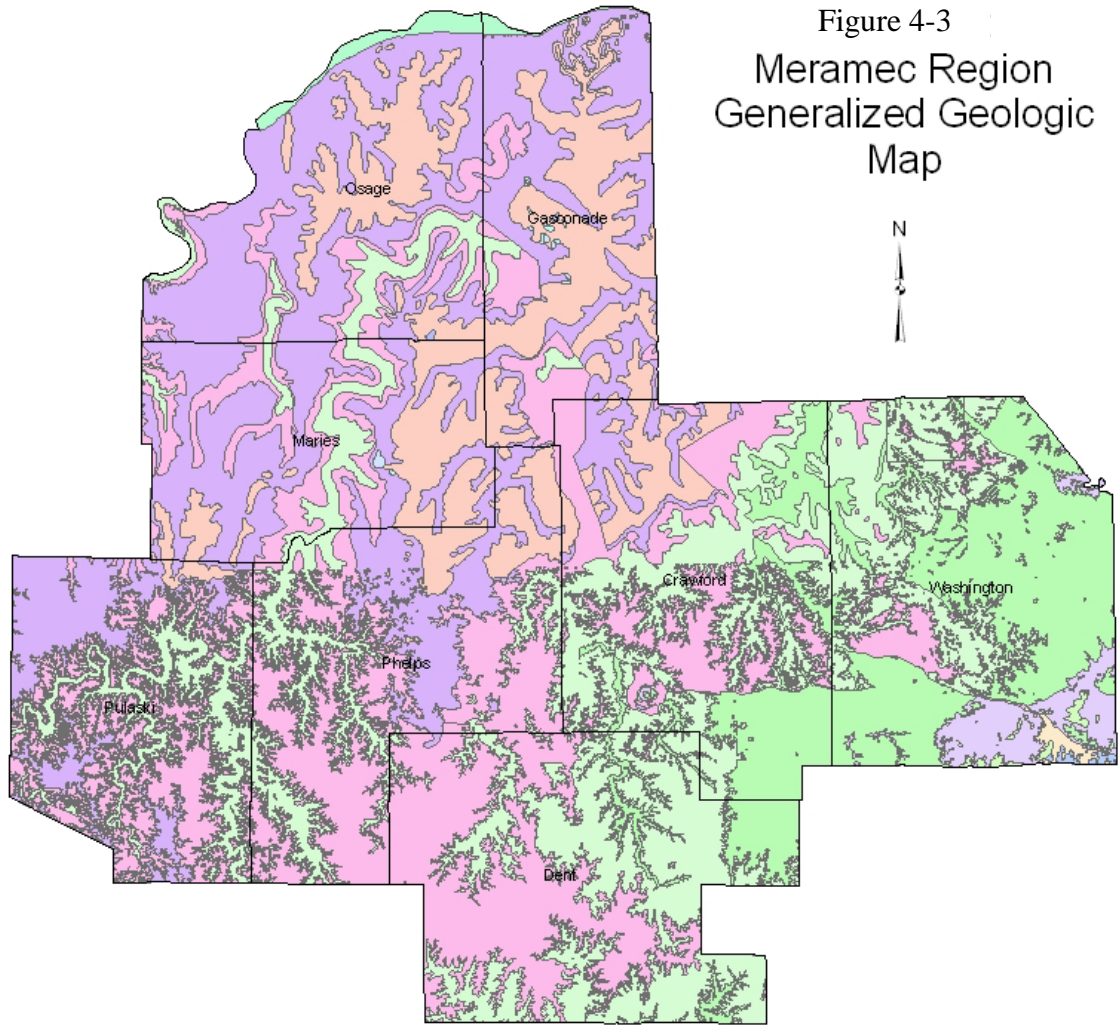


Figure 4-3
 Meramec Region
 Generalized Geologic
 Map




















Legend		
GEOLOGY		
	Cambrian, Elvins & Bonnetere	 Mississippian, Osagean
	Cambrian, Eminence & Potosi	 Ordovician, Gasconade Dolomite
	Cambrian, Lamotte Sandstone	 Ordovician, Jefferson City & Cotter
	Devonian system	 Ordovician, Roubidoux
	Mississippian, Chesterian	 Ordovician, St. Peter and Everton
	Mississippian, Kinderhookian	 Pennsylvanian Marmaton
		 Penn. channel Sandstones
		 Quaternary Alluvium
		 Precambrian diabase
		 Precambrian intrusive
		 Precambrian volcanic

Figure 4-4 **CRAWFORD COUNTY TOPOGRAPHIC MAP**

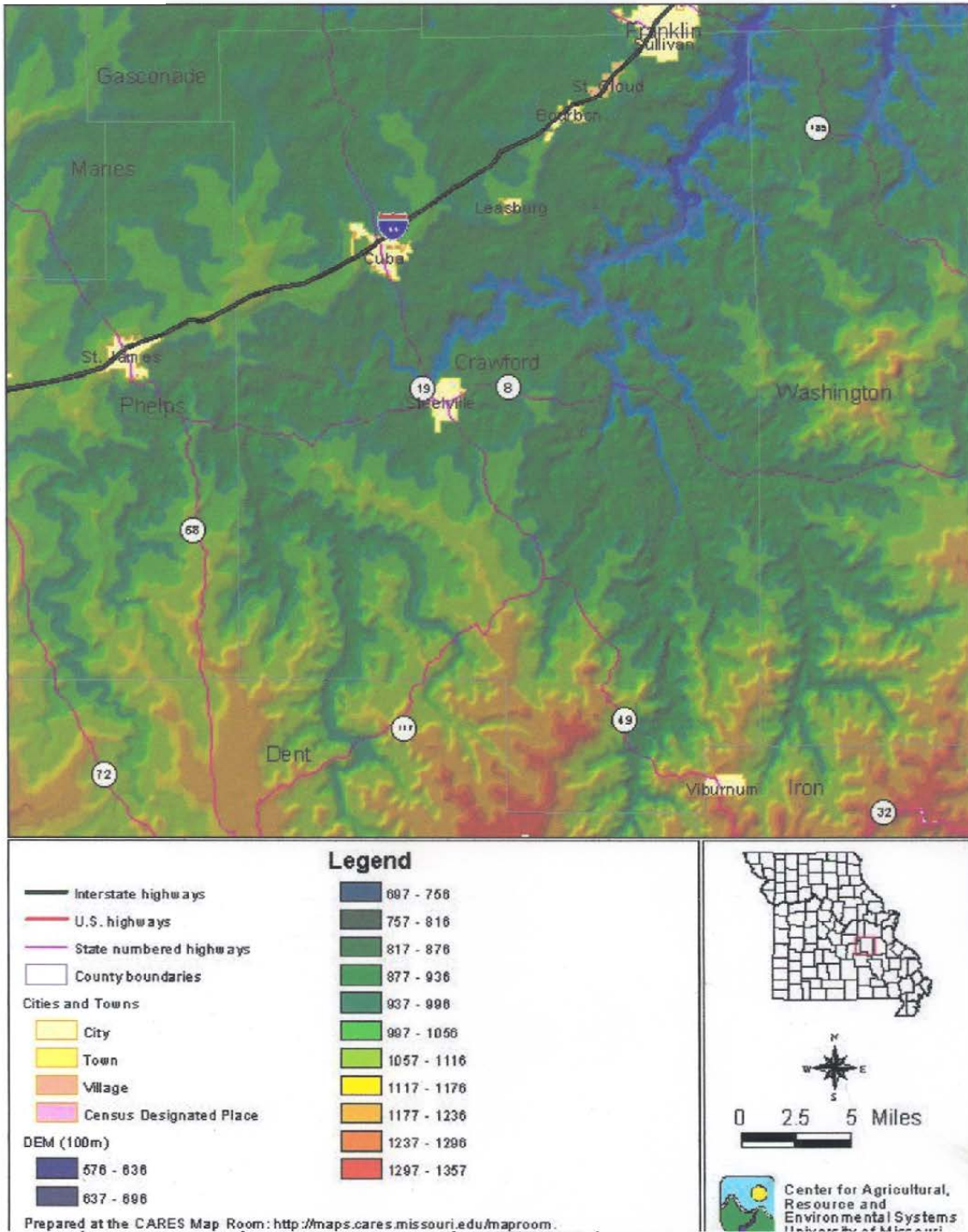


Figure 4-5 **DENT COUNTY TOPOGRAPHIC MAP**

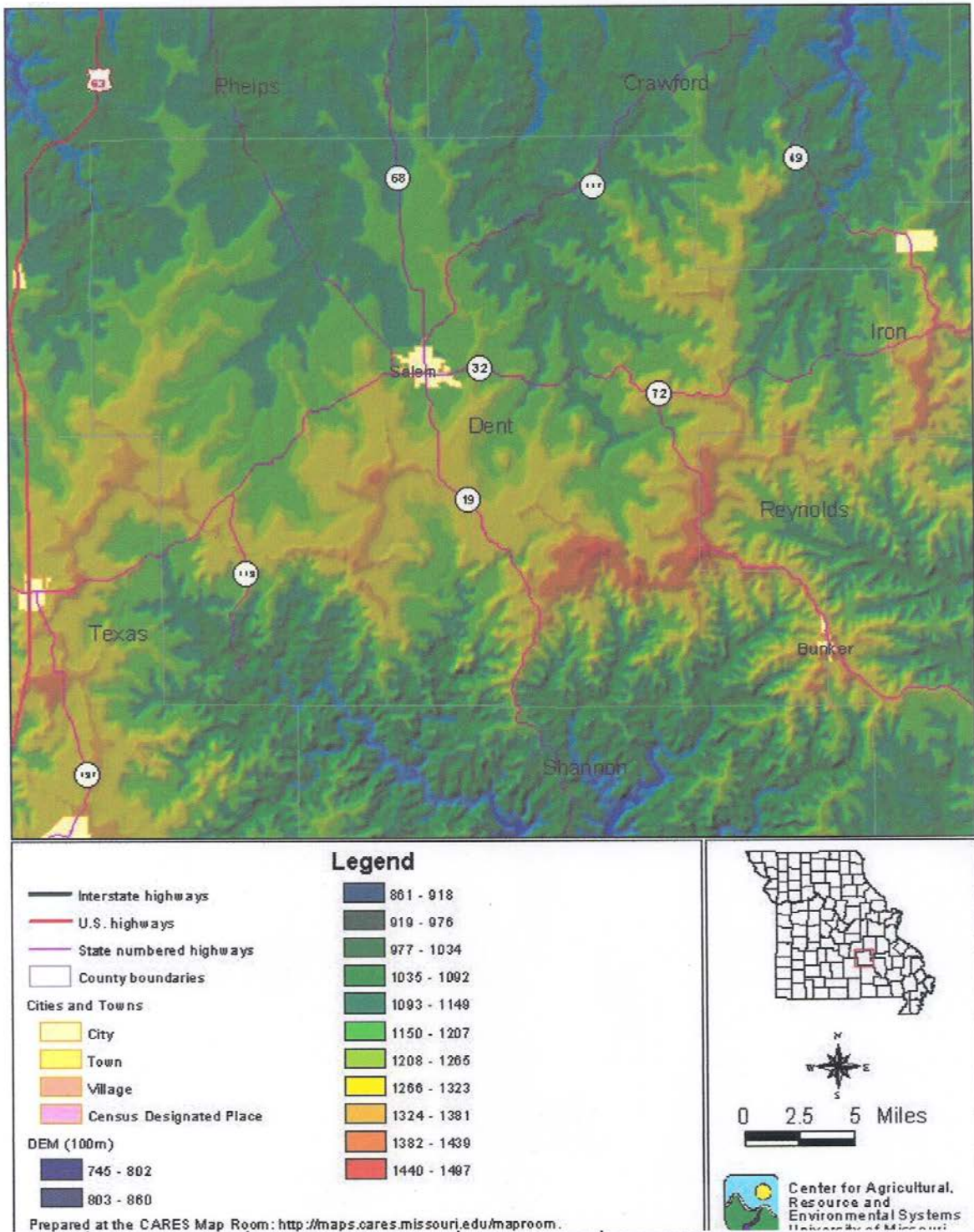


Figure 4-6 **GASCONADE COUNTY TOPOGRAPHY MAP**

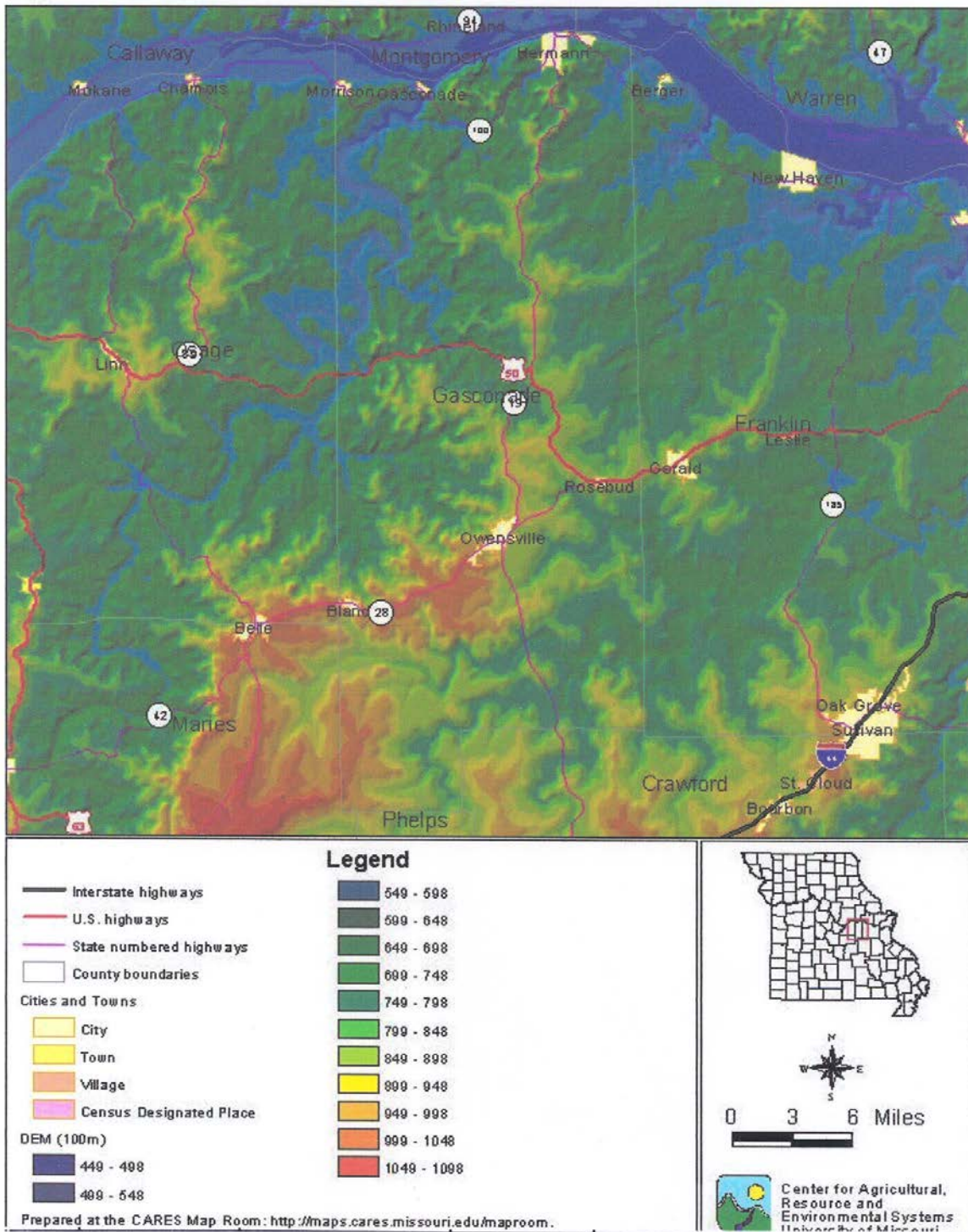


Figure 4-7 **MARIES COUNTY TOPOGRAPHIC MAP**

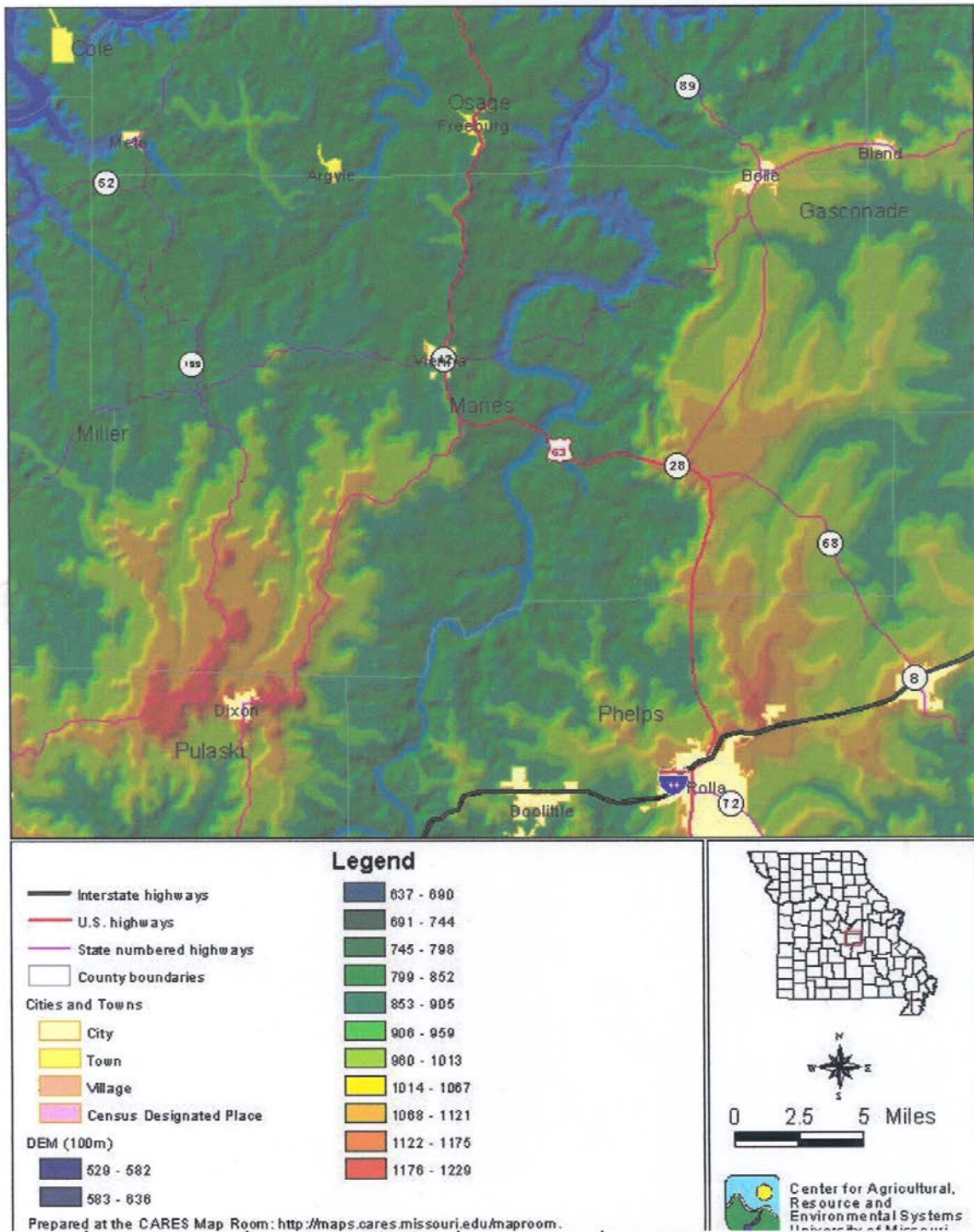


Figure 4-8

OSAGE COUNTY TOPOGRAPHIC MAP

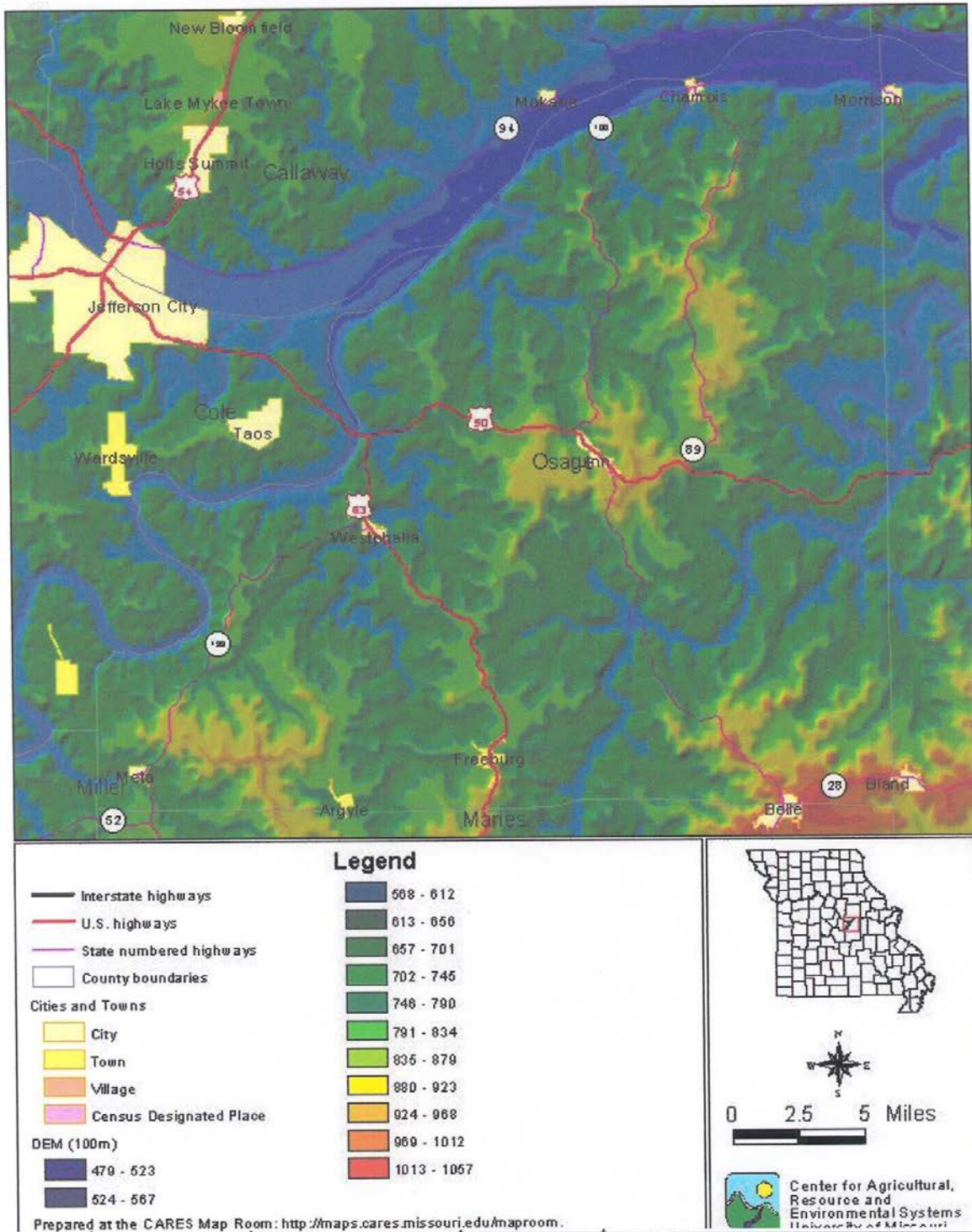


Figure 4-9 PHELPS COUNTY TOPOGRAPHIC MAP

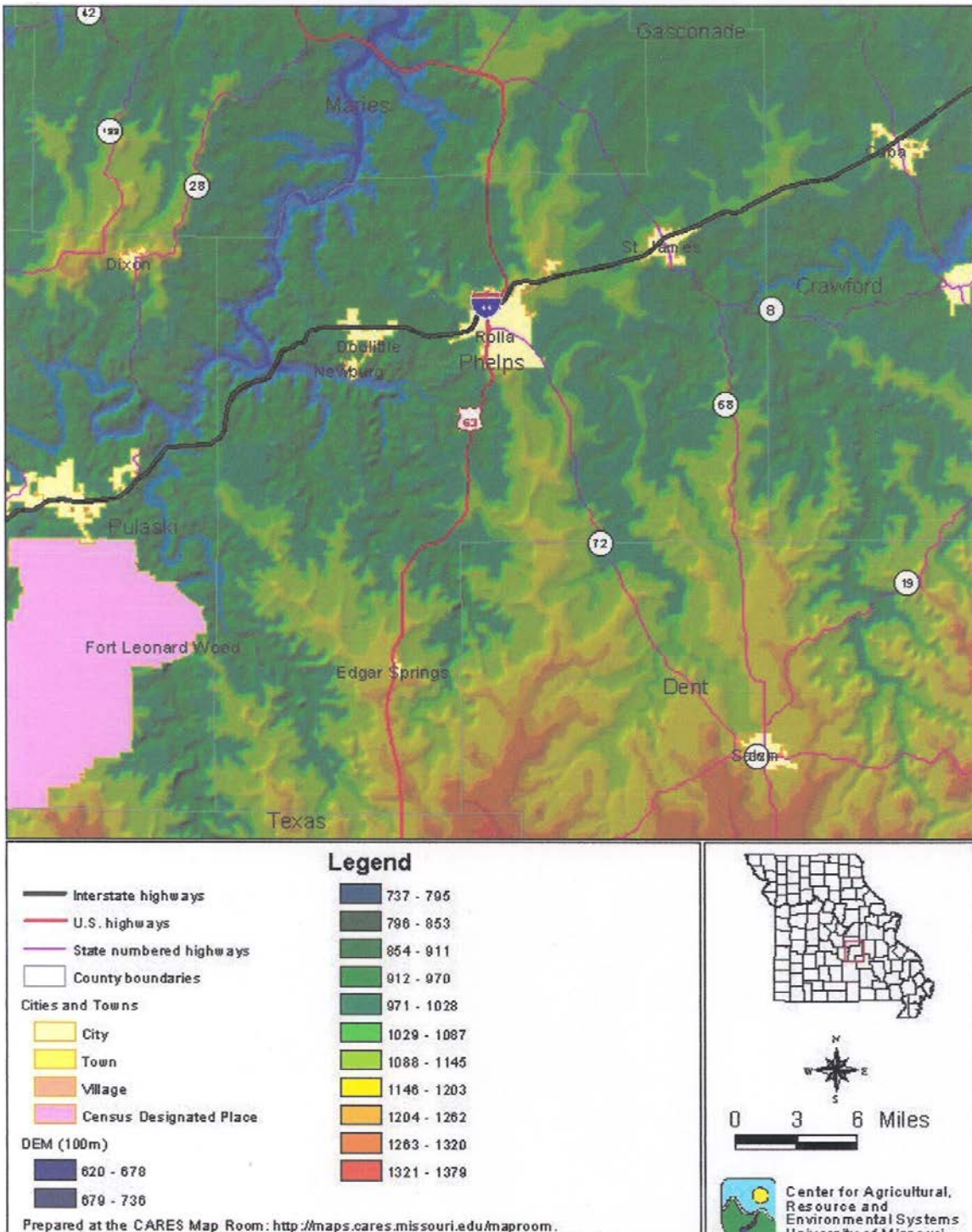
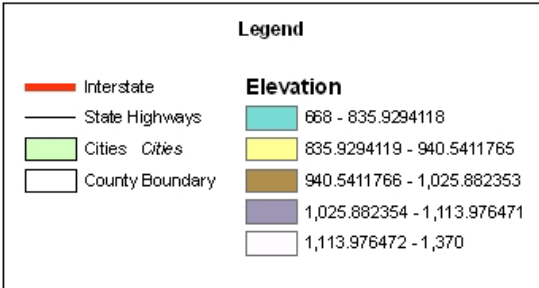
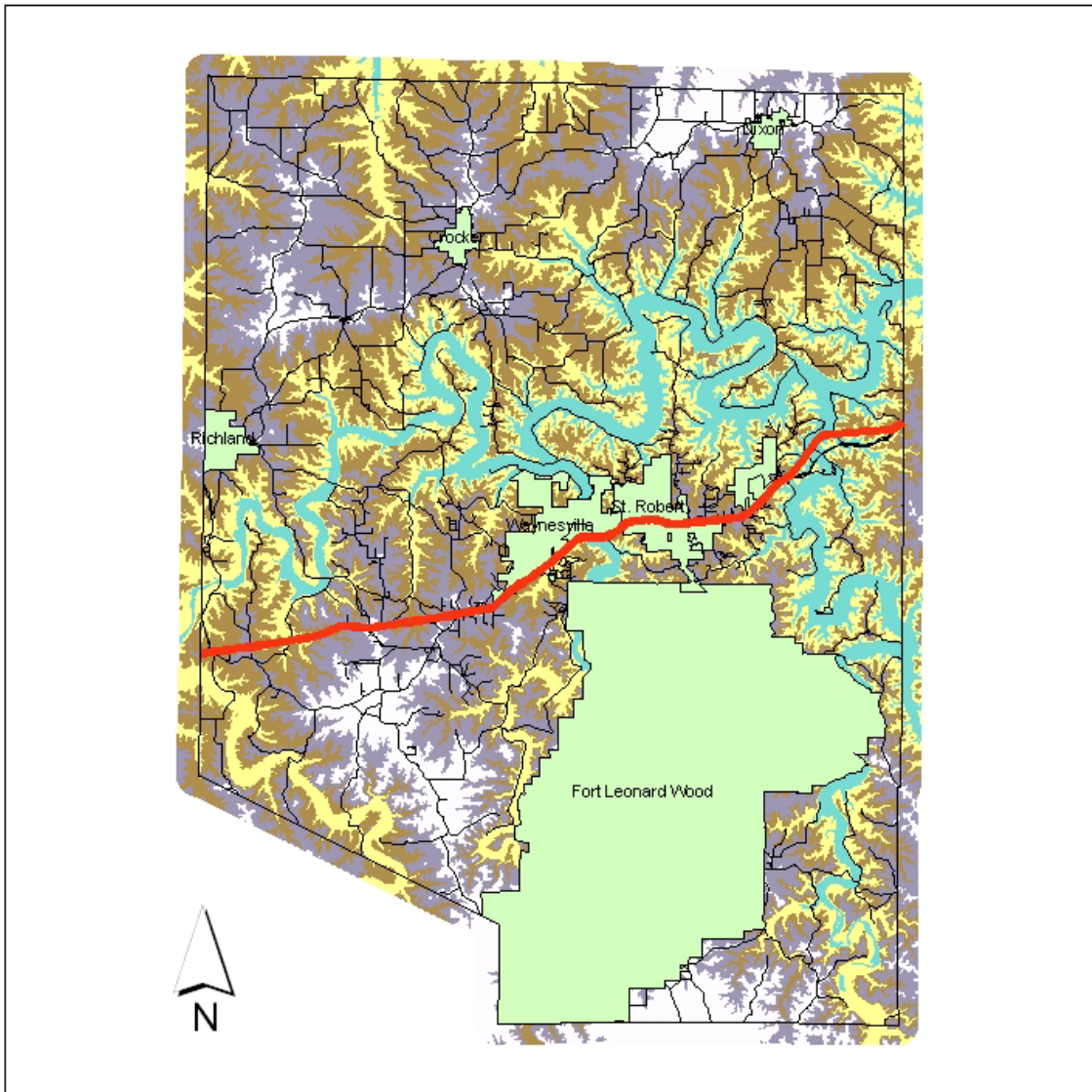


Figure 4-10

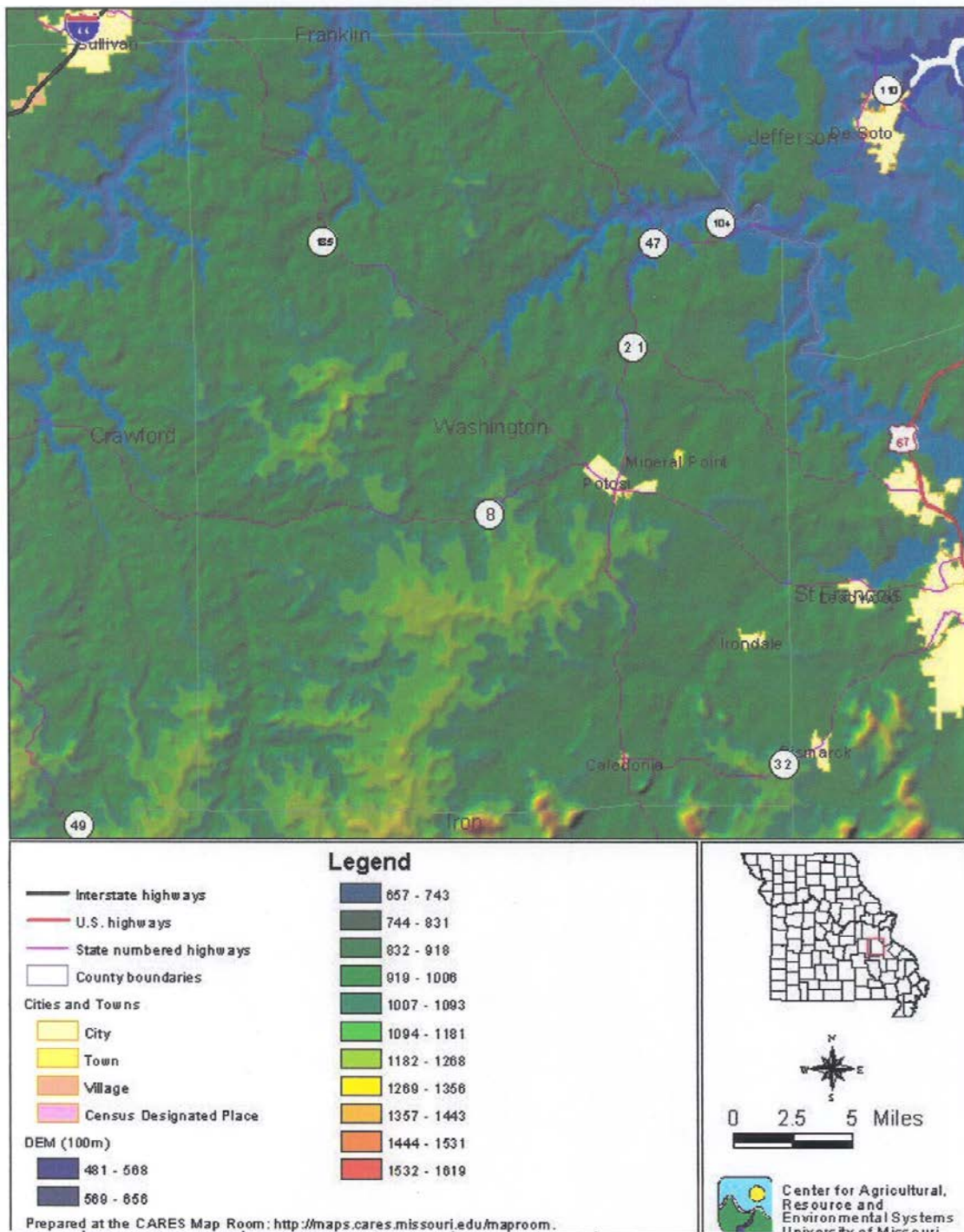
Pulaski County Elevation



Created by the Meramec Regional Planning Commission
4 Industrial Drive
St. James, MO 65559
1/3/08

To the best of the author's knowledge
the data presented here is true and
correct. However, no responsibility is
assumed by the author.

Figure 4-11 WASHINGTON COUNTY TOPOGRAPHIC MAP



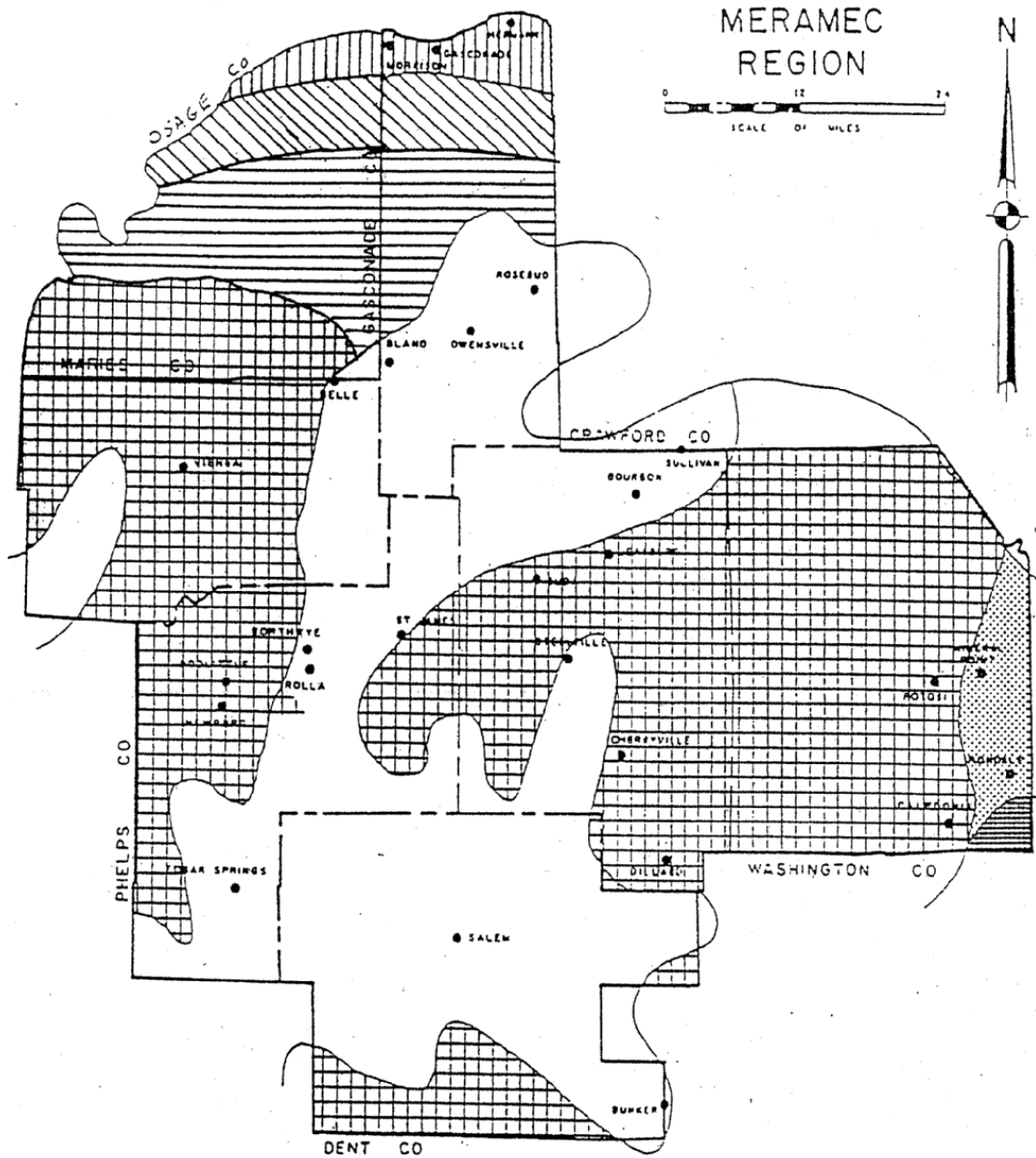


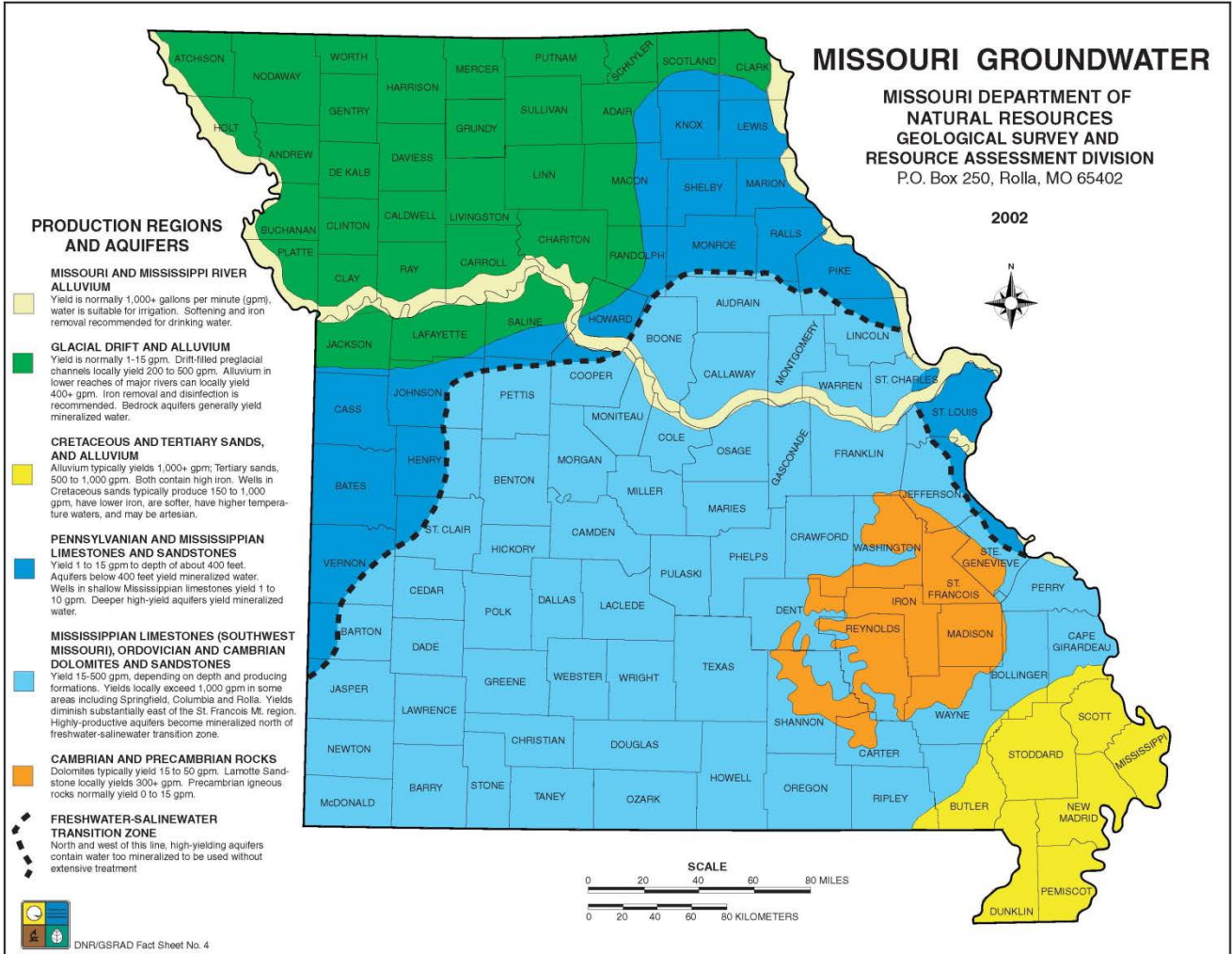
Figure 4-12: **GENERALIZED SOILS MAP**

- | | |
|--|---------------------------|
| Lebanon-Nixa-Clarksville
& Hobson-Clarksville | Menfro-Winfield-Weldon |
| Clarksville-Fullerton-Talbott | Sarpy-Haynie-Onawa-Wabash |
| Union-Fullerton-McGirk | Hagerstown-Tilsit |
| | Ashe-Tilsit-Hagerstown |

Source: Soils of Missouri, Univ. of Mo. Extension Division.

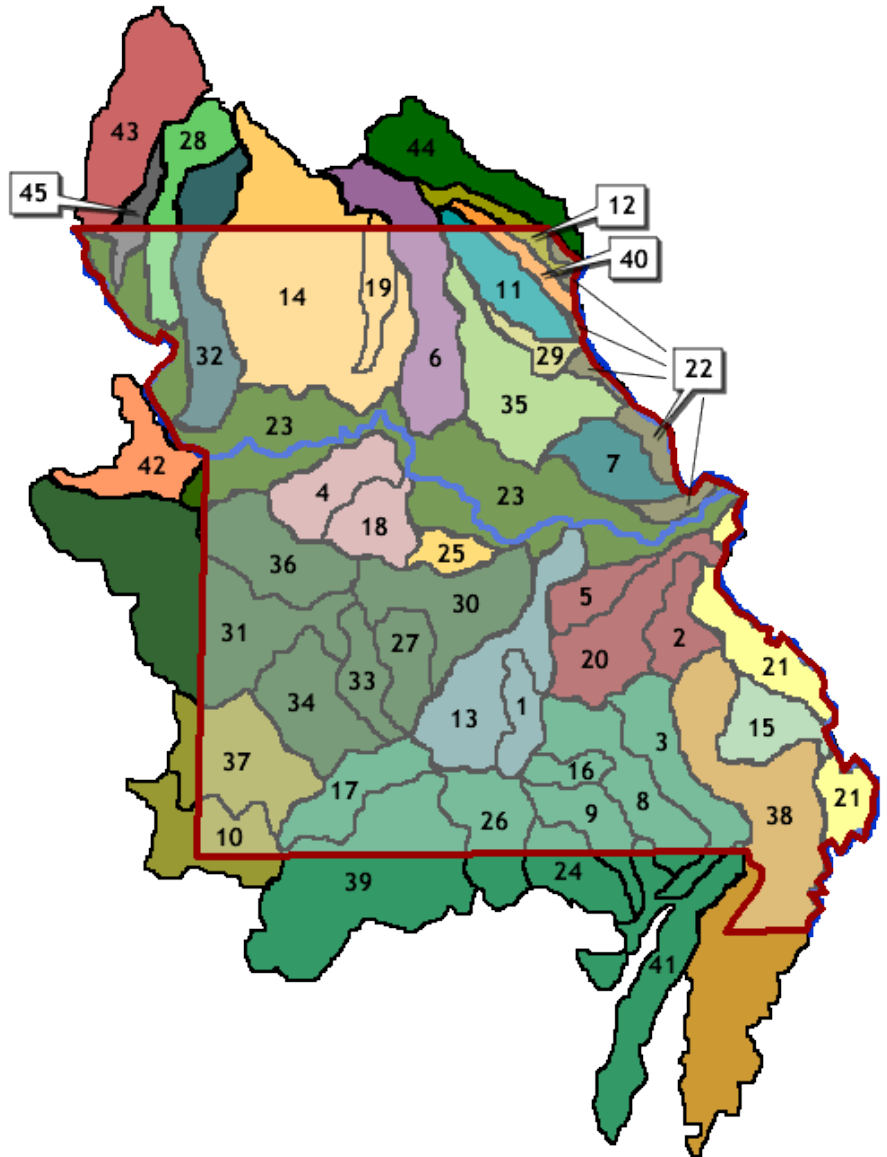
Map 4-13

Missouri Groundwater



Missouri Watersheds Map

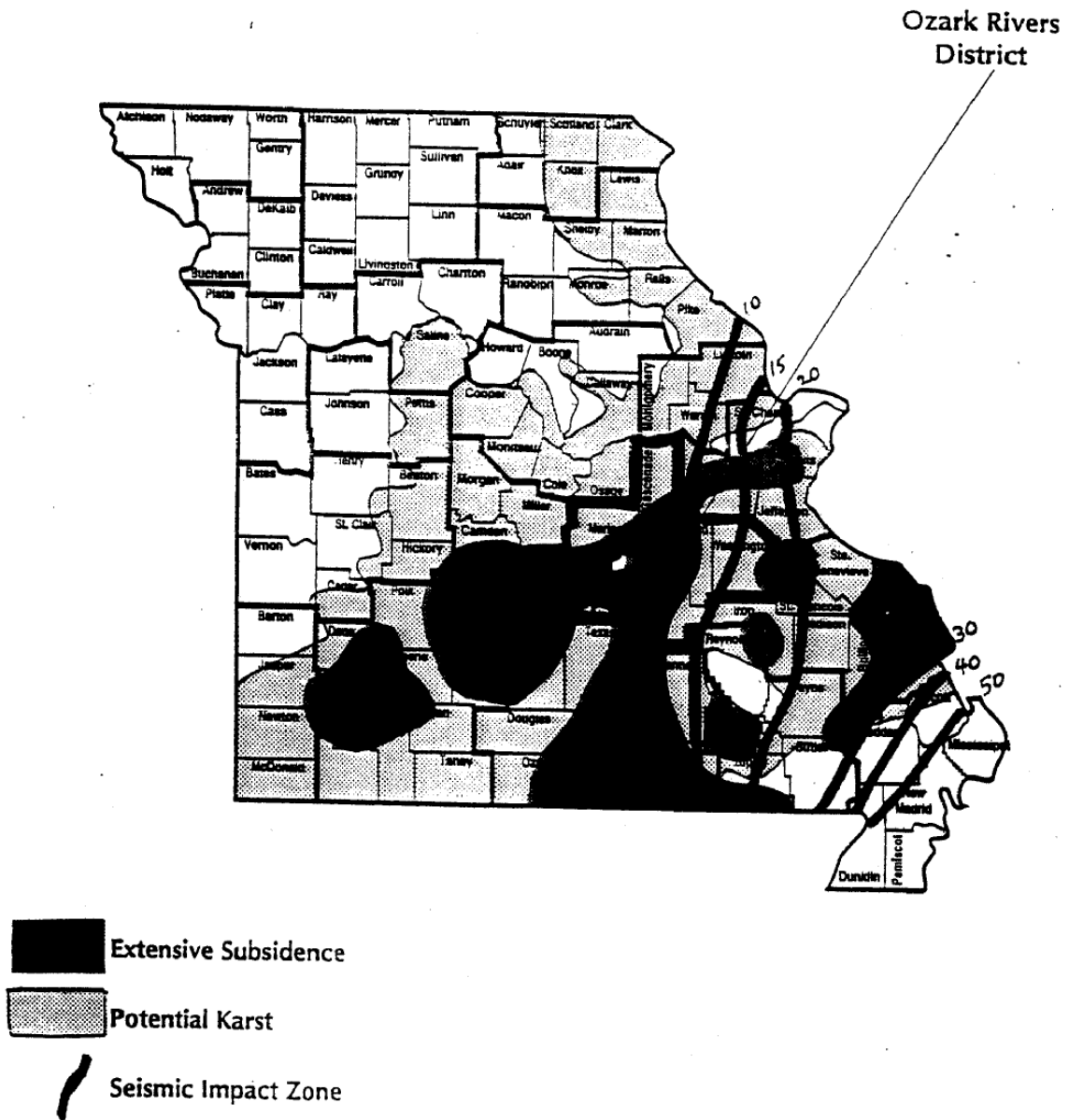
- 1. BIG PINEY RIVER
- 2. BIG RIVER
- 3. BLACK RIVER
- 4. BLACKWATER RIVER
- 5. BOURBEUSE RIVER
- 6. CHARITON RIVER
- 7. CUIVRE RIVER
- 8. CURRENT RIVER
- 9. ELEVEN POINT RIVER
- 10. ELK RIVER
- 11. FABIUS RIVER
- 12. FOX RIVER
- 13. GASCONADE RIVER
- 14. GRAND RIVER
- 15. HEADWATER DIVERSION
- 16. JACKS FORK RIVER
- 17. JAMES RIVER
- 18. LAMINE RIVER
- 19. LOCUST CREEK
- 20. MERAMEC RIVER
- 21. MISSISSIPPI RIVER, LOWER*
- 22. MISSISSIPPI RIVER, UPPER*
- 23. MISSOURI RIVER*
- 1. CROOKED RIVER
- 2. BLUE RIVER
- 24. SPRING RIVER
- 25. MOREAU RIVER
- 26. NORTH FORK WHITE RIVER
- 27. NIANGUA RIVER
- 28. NODAWAY
- 29. NORTH RIVER
- 30. OSAGE RIVER, EAST
- 31. OSAGE RIVER, WEST
- 32. PLATTE RIVER
- 33. POMME de TERRE RIVER
- 34. SAC RIVER
- 35. SALT RIVER
- 36. SOUTH GRAND RIVER
- 37. SPRING RIVER
- 38. ST. FRANCIS RIVER
- 39. WHITE RIVER
- 40. WYACONDA RIVER
- 41. CACHE RIVER *
- 42. LOWER KANSAS RIVER *
- 43. NISHNABOTNA RIVER *
- 44. LOWER DES MOINES RIVER *
- 45. TARKIO RIVER*



Watersheds grouped by color represent the larger watershed to which they belong.
 Watersheds denoted by letters represent sub-basins of watersheds immediately above.
 * No Watershed Inventory and Assessment planned at this time.

Figure 4-15

Landfill Constraints: Karst Terrain & Seismic Zones in Missouri



Graphic Source: Ozark Rivers Solid Waste Management Plan 1993.

Figure 4-16

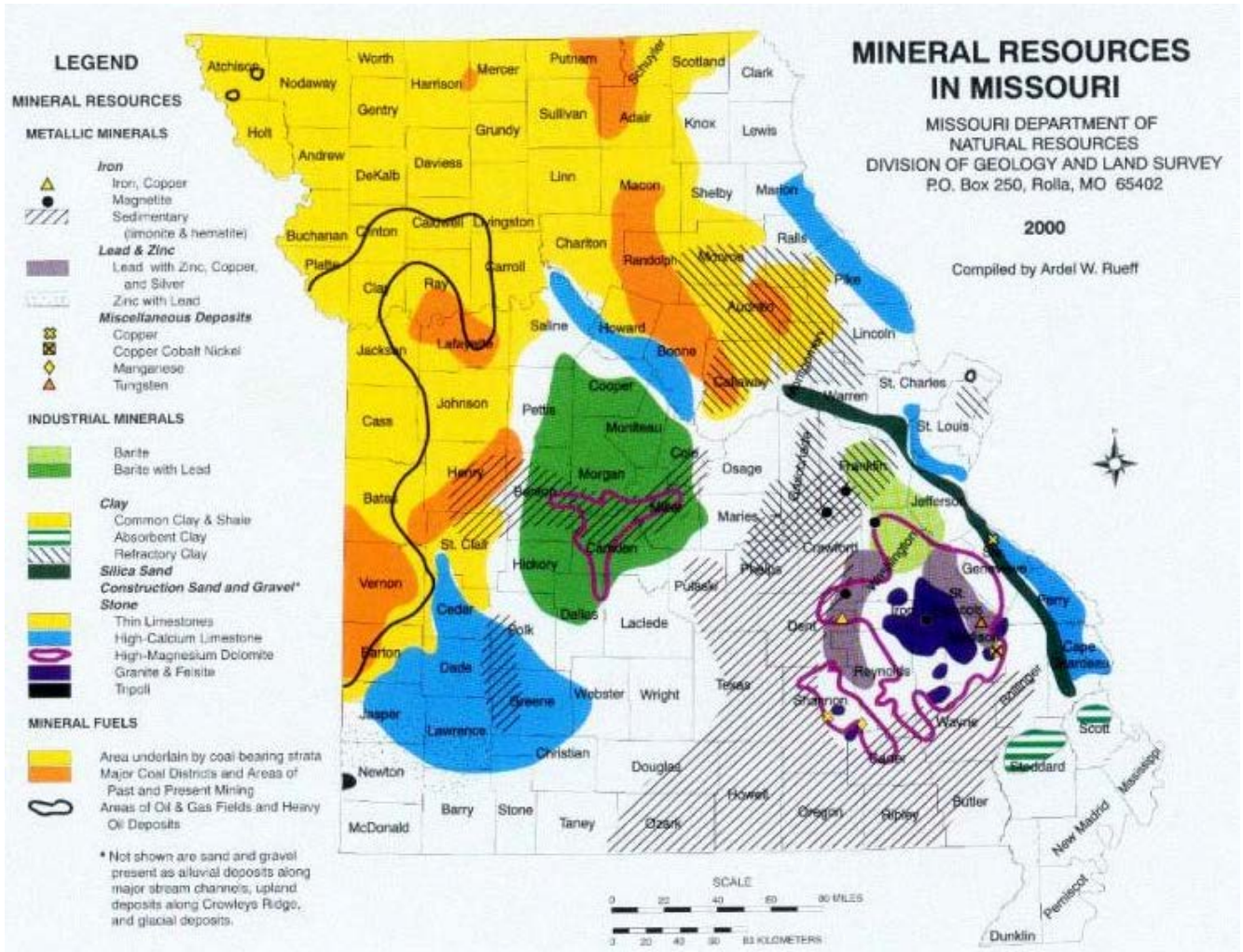


Table 4-1: Population Density Comparisons 2000 - 2010

Based on Entire Land Mass Only

Jurisdiction	Size (sqm)	2010 Population	2010 Density (sqm)	2000 Population	2000 Approx. Density (sqm)
CRAWFORD	742.52	24,696	33.3	22,804	30.7
Bourbon	1.34	1,632	1,217.9	1,348	1,006.0
Cuba	3.20	3,356	1,048.8	3,320	1,037.5
Leasburg	0.43	338	786.0	323	751.2
Steelville	2.42	1,642	678.5	1,429	590.5
Sullivan	7.90	7,081	896.3	6,351	803.9
West Sullivan	0.36	119	330.6	N/I	***
DENT	753.54	15,657	20.8	14,927	19.8
Salem	3.18	4,950	1,556.6	4,854	1,526.4
GASCONADE	520.67	15,222	29.2	15,342	29.5
Bland	0.65	539	829.2	565	869.2
Gasconade	0.20	223	1,115.0	267	1,335.0
Hermann	2.53	2,431	960.9	2,674	1,056.9
Morrison	0.45	139	308.9	123	273.3
Owensville	2.64	2,676	1,013.6	2,500	947.0
Rosebud	0.87	409	470.1	364	418.4
MARIES	527.73	9,176	17.4	8,903	16.9
Belle	1.34	1,545	1,153.0	1,344	1,003.0
Vienna	1.06	610	575.5	628	592.5
OSAGE	606.11	13,878	22.9	13,062	21.6
Argyle	0.40	162	405.0	164	410.0
Chamois	0.37	396	1,070.3	456	1,232.4
Freeburg	0.83	437	526.5	423	509.6
Linn	1.17	1,459	1,247.0	1,354	1,157.3
Meta	0.35	229	654.3	249	711.4
Westphalia	0.53	389	734.0	320	603.8
PHELPS	672.85	45,156	67.1	39,825	59.2
Doolittle	2.68	630	235.1	644	240.3
Edgar Springs	0.65	208	320.0	190	292.3
Newburg	0.61	470	770.5	484	793.4
Rolla	11.83	19,559	1,653.3	16,367	1,383.5
St. James	4.28	4,216	985.0	3,704	865.4
PULASKI	547.02	52,274	95.6	41,165	75.3
Crocker	1.24	1,110	895.2	1,033	833.1
Dixon	1.01	1,549	1,533.7	1,570	1,554.5
Richland	2.27	1,863	820.7	1,805	795.2
St. Robert	7.83	4,340	554.3	2,760	352.5
Waynesville	6.42	4,830	752.3	3,507	546.3
WASHINGTON	759.59	25,195	33.2	23,344	30.7
Caledonia	0.16	130	812.5	158	987.5
Irondale	0.53	445	839.6	437	824.5
Mineral Point	0.24	351	1,462.5	363	1,512.5
Potosi	2.33	2,660	1,141.6	2,662	1,142.5
Region	5,130.03	201,254	39.2	179,372	35.0
State	68,888.50	5,988,927	86.9	5,595,211	81.2
Nation	3,537,619.77	308,745,538	87.3	281,421,906	79.6

SOURCE: 2000 & 2010 Census, U.S. Census Bureau

Table 4-2

**INCORPORATED PLACES
LOCATED IN THE MERAMEC REGION
BY COUNTY**

Crawford County: Bourbon, Cuba, Leasburg, Steelville, Sullivan¹, West Sullivan

Dent County: Salem

Gasconade County: Bland, Gasconade, Hermann, Morrison, Owensville, Rosebud

Maries County: Belle², Vienna, Argyle²

Osage County: Argyle², Belle², Chamois, Freeburg, Linn, Meta, Westphalia

Phelps County: Doolittle, Edgar Springs, Newburg, Rolla, St. James

Pulaski County: Crocker, Dixon, Richland³, St. Robert, Waynesville

Washington County: Caledonia, Irondale, Mineral Point, Potosi

SOURCE: 2000 Census of Population, U.S. Census Bureau

¹Partially in Franklin County

²Partially in Osage County, partially in Maries County

³Partially in Laclede and Camden County

Table 4-3

AGRICULTURAL LAND USES BY COUNTY
IN THE MERAMEC REGION

COUNTY	Number of Farms				Farmland in Acres				Avg. Size Farm in Acres			
	1987	1997	2002	2007	1987	1997	2002	2007	1987	1997	2002	2007
Crawford	713	789	751	679	200,323	197,867	217,667	186,999	281	251	290	275
Dent	731	821	693	651	221,327	235,914	210,108	176,601	303	287	303	271
Gasconade	846	839	877	867	208,982	195,655	222,214	212,641	247	233	253	245
Maries	834	892	883	898	232,689	238,498	234,381	240,376	279	267	265	268
Osage	1,160	1,242	1,219	1,181	300,812	309,143	314,788	297,477	259	249	258	252
Phelps	773	867	824	826	202,453	212,236	201,067	175,849	262	276	315	213
Pulaski	528	614	573	481	139,937	148,183	141,649	123,074	265	241	247	256
Washington	508	561	573	558	121,699	137,258	132,718	137,304	240	245	230	246
Meramec Region	6,093	6,625	6,393	6,141	1,628,222	1,674,754	1,674,592	1,550,321	267	253	262	253
State	106,105	110,986	106,797	107,825	29,209,187	30,202,772	29,946,035	29,026,573	275	272	280	269

COUNTY	Cropland in Acres				Harvested Cropland in Acres				Total Woodland			Total Pastureland		
	1987	1997	2002	2007	1987	1997	2002	2007	1997	2002	2007	1997	2002	2007
Crawford	74,727	88,559	85,121	49,599	21,694	30,343	34,419	28,357	71,975	78,067	65,087	27,328	47,045	64,395
Dent	91,409	98,861	79,894	41,087	21,755	30,301	27,804	23,102	89,778	72,310	57,218	40,339	51,727	71,729
Gasconade	98,095	98,296	105,313	81,379	46,829	52,300	64,684	59,577	71,722	78,308	69,390	17,833	26,712	48,447
Maries	95,498	108,115	106,046	70,335	36,630	46,395	55,686	48,146	72,456	73,082	72,134	49,896	47,789	89,880
Osage	131,157	140,822	132,629	100,245	62,855	70,408	78,846	72,724	102,711	104,788	99,093	55,573	65,657	86,520
Phelps	78,805	87,667	73,200	51,589	23,570	30,771	30,473	27,054	74,335	65,620	57,602	43,234	51,803	59,380
Pulaski	58,544	67,908	62,724	33,625	16,298	23,066	25,261	18,390	48,968	46,462	41,150	26,293	28,834	44,874
Washington	48,789	56,161	54,974	41,299	14,728	19,833	24,865	24,126	54,916	47,017	52,554	18,835	21,700	38,339
Meramec Region	677,024	746,389	699,901	469,158	244,359	303,417	342,038	301,476	586,861	565,654	516,235	279,331	341,267	503,564
State	19,378,031	19,926,421	18,884,920	16,405,595	11,655,304	12,850,509	13,137,184	12,980,113	4,924,638	4,852,574	4,414,396	3,941,666	4,854,438	6,854,438

Sources: 1987 & 2002 Census of Agriculture, U.S. Census Bureau, Table 8 - Farms, Land in Farms, Value of Land and Buildings, and Land Use: 2002 and 1997

http://www.nass.usda.gov/census/census02/volume1/mo/st29_2_008_008.pdf

http://www.aqcensus.usda.gov/Publications/2007/Full_Report/Volume_1_Chapter_2_County_Level/Missouri/st29_2_001_001.pdf

Table 4-4
Net Volume (cuft) of Live Trees on Timberland (greater than 5" dia.) in the Meramec Region

County	Pine	Other Softwoods	Soft Hardwoods	Hard Hardwoods	Total
Crawford	1,195,131	10,381,904	26,378,635	300,604,425	338,560,095
Dent	36,157,402	4,237,750	11,585,434	365,393,892	417,374,479
Gasconade	0	18,404,963	36,243,421	185,819,232	240,467,617
Maries	0	17,689,768	5,704,608	139,425,231	162,819,606
Osage	0	18,406,766	19,707,962	207,006,841	245,121,569
Phelps	6,840,948	13,969,631	20,774,283	276,447,899	318,032,762
Pulaski	1,503,160	11,973,238	37,109,731	249,155,127	299,741,255
Washington	52,973,392	19,660,890	17,593,029	385,723,053	475,950,363
Meramec Region	98,670,032	114,724,910	175,097,103	2,109,575,700	2,498,067,746

Source: 2012 Forest Inventory, <http://apps.fs.fed.us/fia/fido/customrpt/app.html#display-output>

Table 4-5
Net Volume (cuft) of Growing-stock on Timberland (greater than 5" dia.) in the Meramec Region

County	Pine	Other Softwoods	Soft Hardwoods	Hard Hardwoods	Total
Crawford	1,048,224	6,089,312	20,994,149	279,684,275	307,815,960
Dent	36,128,909	1,801,034	8,121,786	318,324,113	364,375,841
Gasconade	0	5,074,818	32,474,338	152,885,256	190,434,412
Maries	0	11,753,993	3,996,240	115,436,670	131,186,903
Osage	0	4,909,519	11,138,753	181,691,333	197,739,605
Phelps	6,687,642	4,428,334	15,383,764	226,785,777	253,285,517
Pulaski	1,503,160	4,964,371	31,126,691	217,146,569	254,740,790
Washington	51,778,137	9,475,038	14,800,699	341,290,088	417,343,963
Meramec Region	97,146,071	48,496,418	138,036,420	1,833,244,081	2,116,922,991

Source: 2012 Forest Inventory, <http://apps.fs.fed.us/fia/fido/customrpt/app.html#display-output>

Table 4-6
Average Mortality of Growing-stock trees on Timberland
(greater than 5" dia.) in cubic feet in the Meramec Region

County	Pine	Other Softwoods	Soft Hardwoods	Hard Hardwoods	Total
Crawford	0	0	484,066	1,171,743	1,655,809
Dent	377,773	0	27,545	2,830,476	3,235,793
Gasconade	0	14,870	69,106	588,840	672,816
Maries	0	12,361	565,236	1,559,410	2,137,007
Osage	0	0	371,082	363,608	734,690
Phelps	14,319	0	499,469	917,522	1,431,310
Pulaski	0	14,895	705,096	1,452,563	2,172,555
Washington	229,826	0	42,306	4,350,019	4,622,151
Meramec Region	621,918	42,126	2,763,907	13,234,181	16,662,131

Source: 2012 Forest Inventory, <http://apps.fs.fed.us/fia/fido/customrpt/app.html#display-output>

Table 4-7
Average Annual Harvest removals of Growing-stock trees on Timberland
(greater than 5" dia.) in cubic feet in the Meramec Region

County	Pine	Other Softwoods	Soft Hardwoods	Hard Hardwoods	Total
Crawford	0	205,762	108,561	2,314,717	2,629,040
Dent	0	0	0	1,299,990	1,299,990
Gasconade	0	181,472	0	0	181,472
Maries	0	68,394	136,606	1,029,439	1,234,439
Osage	0	0	0	0	0
Phelps	0	0	0	44,901	44,901
Pulaski	0	0	0	481,812	481,812
Washington	2,955,441	46,739	7,151	5,879,971	8,889,302
Meramec Region	2,955,441	502,367	252,317	11,050,829	14,760,955

Source: 2012 Forest Inventory, <http://apps.fs.fed.us/fia/fido/customrpt/app.html#display-output>

Table 4-8
Average Annual Net Growth of Growing-stock trees on Timberland
(greater than 5" dia.) in cubic feet in the Meramec Region

County	Pine	Other Softwoods	Soft Hardwoods	Hard Hardwoods	Total
Crawford	41,826	284,482	314,207	5,521,635	6,162,151
Dent	803,761	154,220	336,022	8,848,550	10,142,553
Gasconade	0	369,050	1,049,261	3,248,093	4,666,404
Maries	0	454,269	112,484	2,321,993	2,888,746
Osage	0	196,331	520,426	4,607,052	5,323,808
Phelps	90,117	193,051	222,555	5,977,529	6,483,252
Pulaski	38,433	282,414	13,843	5,337,920	5,672,610
Washington	1,428,868	322,912	460,274	5,006,691	7,218,744
Meramec Region	2,403,006	2,256,729	3,029,072	40,869,463	48,558,270

Source: 2012 Forest Inventory, <http://apps.fs.fed.us/fia/fido/customrpt/app.html#display-output>

Table 4-9

MINES and QUARRIES IN THE MERAMEC REGION

Parent Company	Quarry/Mine Name	Product	Operation
Crawford			
Crawford Lime & Materials, Inc.	Brush Creek Quarry	Crushed Stone	Mine & Plant
Georgia-Pacific Corp	Cuba Plant	Perlite	Plant
Dent			
Capital Quarries Inc	Salem Quarry (Plant 7)	Aggregates for concrete, asphalt, road stone & base; aglime	Mine & Plant
Gasconade			
Capital Quarries Inc	Hermann Quarry (Plant 14)	Commercial aggregates	Mine & Plant
Capital Quarries Inc	Owensville Quarry (Plant 13)	Aggregates for asphalt, road stone and base	Mine & Plant
Dillon Clay Mng Co	Crawford County Pits	Common Clay and Shale	Mine & Plant
First Creek Quarry	First Creek Quarry	Crushed Limestone	Mine & Plant
Osage			
Capital Quarries Inc	Linn Quarry (Plant 20)	Asphalt aggregate, road stone and base	Mine & Plant
Higgins Quarry	Higgins Quarry	All types of crushed stone, aglime	Mine & Plant
Muenks Bros. Quarries, Inc.	Muenks Bros. Quarry	Crushed Stone	Mine & Plant
Phelps			
Capital Quarries Inc	Rolla Quarry	Crushed Stone	Mine & Plant
Capital Quarries Inc	Hwy Y Quarry (Plant 21)	Asphalt aggregate, road stone and base; sand; aglime; riprap	Mine & Plant
Capital Quarries Inc	Jerome Quarry (Plant 19)	Commercial aggregates	Mine & Plant
Capital Sand Co., Inc	Jerome (Plant 11)	Sand & Gravel	Mine & Plant
Havin Materials Service, Inc	Havin Materials Service, Inc	Sand & Gravel	Mine & Plant
Capital Quarries Inc	Hwy Y Quarry (Plant 21)	Asphalt aggregate, road stone & base; sand; aglime; riprap	Mine & Plant
Southwest Quarry & Material, Inc	Southwest Quarry	Crushed Stone	Mine & Plant
Pulaski			
Willard Quarries, Inc.	St. Robert Quarry	Crushed Stone	Mine & Plant
Woodlane Rentals Partnership	Cave Sand & Gravel	Sand & Gravel	Mine & Plant
Washington			
Cimbar Performance Minerals	Fountain Farm Plant	Barite	Plant
Lafarge North America, Inc.	Pea Ridge Plant	Crushed Stone	Mine & Plant

Source: www.momic.com; www.molimestone.com; 2013 Missouri Directory of Manufacturers