UMI FIELD TOUR

Guidebook

Blues Highway 61

Red Hills Mine

Civil War Military Park

Tinsley Oil Field

ERDC

Underwater Mining Institute
38th Annual Conference

Hosted by The University of Mississippi
November 20-21, 2008
UMI FIELD TOUR
November 20 - 21, 2008
GUIDEBOOK

Written, Edited, and Design Layout by:
Emily E. Woolsey
& Brian L. Walker

Illustrated by:
Brian L. Walker

Underwater Mining Institute
38th Annual Conference
Hosted by The University of Mississippi

Technical Program Chair: Dr. Charles L. Morgan
Technical Program Co-Chair and Host: Dr. Robin C. Buchannon
Conference Coordinator: Ms. Karynne Morgan
Field Tour Coordinators: Charles T. Swann and Jeremy Dew

Printed by University of Mississippi Printing Services
This guide book is dedicated to my parents and in loving memory of my father,
Dr. James Robert Woolsey Jr.


Memorial contributions can be made to the:
J.R. Woolsey Geology and Geological Engineering Memorial Scholarship
c/o University of Mississippi Foundation
P.O. Box 249
University, MS 38677
Itinerary

Thursday, November 20, 2008

7:00 a.m. Depart from University of Mississippi campus in Oxford, MS

Route from Oxford to Vicksburg through the Delta along historic Blues Highway 61

11:30 a.m. Arrive in Vicksburg, drive by riverside murals along floodwall on way to lunch at Walnut Hills Round Table Restaurant

1:00 p.m. Tour Geotechnical Lab at Engineering Research & Development Center (ERDC) in Vicksburg

3:00 p.m. Visit Vicksburg National Military Park until closing*

Evening Accommodations at the Ameristar Hotel and casino on the Mississippi River

Friday, November 21, 2008

7:30 a.m. Depart from hotel in Vicksburg for Tinsley

8:30 a.m. Tour Tinsley Oil Field

11:15 a.m. Arrive in Indianola for lunch at the Crown in Town Restaurant

2:30 p.m. Tour Red Hills Mine in Ackerman**

7:30 p.m. Arrive back in Oxford for dinner

Bus will continue on after dinner to the Marriott Courtyard Hotel at the Memphis International Airport

*Comfortable walking shoes recommended

**Hiking boots recommended
Sardis Lake Dam

Located on the Tallahatchie River, Sardis Lake is a 98,520-acre (398.7 km²) water resource development project occupying parts of three North Mississippi counties. The dam site is nine miles (14 km) southeast of the town of Sardis, and is only an hour drive south from Memphis, Tennessee. Becoming operational in October 1940, the dam embodied some of the most advanced design and construction methods of its day. At 15,300 feet (4,700 m) in length, and with an average height of 97 feet (30 m), Sardis Dam was for many years the largest earth-filled type in the world!

Sardis Dam construction began in the mid 1930’s to control the water from the Tallahatchie River for flood protection of the rich delta farmlands in west Mississippi. The dam project, requiring a labor force close to a thousand, had the added benefit of providing much needed economic stimulus for a region extremely hard hit by the depression. Thousands of men toiled, doing backbreaking work using mules, brush hooks, crosscut saws and axes to clear fourteen miles (21 km) along the Tallahatchie River, characterized by cutover hardwood, dense undergrowth and meandering sloughs.

The most distinctive aspect of the dam's construction was the use of "hydraulic fill" techniques. This required that soil be dredged from the river below the dam site and pumped up to provide the earth fill that forms the major portion of the dam. The dredging operation created the 425 acre (1.72 km²) “Lower Lake” on the downstream side of Sardis Dam.

Sardis Lake has a maximum storage capacity of 1,512,000 acre feet (1.865×10^9 m³) of water. During the fall and winter months the lake is gradually drawn down to a "conservation pool" of 9,800 acres (40 km²). This allows for storage of spring rains from the 1,545-square-mile (4,000 km²) drainage area above the dam. Sardis Lake has performed its flood control mission admirably well. The dam's emergency spillway has only been overtopped three times by unprecedented high water in 1973, 1983 and 1991. The lake's normal "recreation pool" is 32,500 acres (132 km²). Annual visitation tops 5 million people and its close proximity to the University of Mississippi makes it popular with the students.
Connecting New Orleans to Chicago, Highway 61 transported the culture and music of the Blues across the nation. Hwy. 61 cuts through the heart of the Mississippi Delta, a region encompassing the floodplains from Memphis, Tennessee in the north to the heights of Vicksburg, Mississippi in the south. Blues greats such as Muddy Waters, hopped trains outside Clarksdale, Greenville, and other Delta towns and migrated north to Chicago in the mass black migrations of the 1930's and 40's. The music of Delta legends such as Willie Dixon, Charlie Patton, Muddy Waters, and B.B. King would go on to influence not only American culture and music, but the history and development of music around the world.

The historic "Crossroads" blues legend takes place at the junction of Hwy. 49 and Hwy. 61 near Clarksdale, MS. According to legend, it is this crossroads where infamous Blues guitarist Robert Johnson sold his soul to the Devil in exchange for the ability to play the guitar.

The history of the Mississippi Delta is tied to agriculture. Mass cultivation in the area began in the early 1800's and consisted primarily of raising cotton, a valuable textile on the domestic and international markets. At the time, cotton could only be harvested by hand, and plantation owners found slavery to be the most economic means of producing a profitable crop with the cheapest labor. Hence the owners of great plantations on the Mississippi Delta grew rich, and the cotton fields spread throughout the floodplain.

The Civil War brought an end to the slavery system of labor, but was followed by a share cropping system which kept the poor black inhabitants of Mississippi in economic bondage. Fieldhands’ laments, songs of struggle, field work songs, and gospels laid the foundations for the Blues.

A recent revival of interest in the Blues culture has provided many Delta towns and businesses with opportunities to benefit from their historical past, and their living Blues culture. Oscar winning actor Morgan Freeman owns the blues club Ground Zero in Clarksdale, and famous Blues musician B.B. King has a new museum dedicated to him in Indianola, where King plays an annual concert for his hometown. The Blues Trail can be followed from New Orleans to Chicago on Highway 61, and is marked with signs explaining the Blues history in each area.
While gazing off into the flat landscape and vast fields of the Mississippi Delta, recall what life was like here before the end of the Civil War, back when cotton was picked by hand. The harsh life of those working day in and day out with no respect and few possessions besides the tattered clothes on their back, was eventually replaced by mechanized agriculture. The great plantations which formerly made cotton barons rich now have to compete with cheaper international markets, diminishing their economic and social significance. Although the Delta’s economic importance has declined, the southern traditions and spirit of the people who worked this land endures through the Blues, African American history, and the impacts of this area on world culture.
Named after the walnut trees that grew along the loess bluffs, Walnut Hills Restaurant is situated in downtown historic Vicksburg. Walnut Hills provides a good old-fashioned Southern home-cooked meal as well as a friendly atmosphere.

**Typical Menu**

- Fried Chicken
- Country Fried Steak
- Catfish
- Biscuits & Cornbread
- Mashed Potatoes
- Mustard Greens
- Black-eyed Peas
- Creamed Corn
- Squash
- Fried Okra
- Green Beans
- Coleslaw
- Iced Tea
- Blackberry Cobbler
- Chocolate Pudding
The Mission of the Engineer Research and Development Center (ERDC) is to provide science, technology, and expertise in engineering and environmental sciences in support of our Armed Forces and the Nation to make the world safer and better.

ERDC Laboratories Include: Coastal and Hydraulics Lab, Cold Regions Research and Engineering Lab, Construction Engineering Lab, Environmental Lab, Geotechnical and Structures Lab, Information Technology Lab, and Topographic Engineering Center

Geotechnical and Structures Laboratory
Vehicle Mobility and Trafficability
Soil and Rock Mechanics
Foundation Design
Embarkment Design
Slope Stability
Seepage Analysis
Earthquake Engineering
Engineering Geology
Geophysics
Pavement Technology
Expedient Surfacing
Dust Control
Force Protection
Geotechnical and Structures Laboratory (GSL)

Description

The Geotechnical and Structures Laboratory (GSL) serves the US Army and the Nation by developing solutions to challenges in geotechnical and structural engineering and related disciplines. GSL has a rich history, dating to the early 1930s, and is today a vital organization of more than 350 engineers, scientists, technicians, and administrative and support personnel. More than 73 percent of the engineers and scientists hold advanced degrees, and each GSL team member is dedicated to providing customer support of the highest quality.

GSL is the ERDC lead for Military Engineering and serves as the Department of Defense (DoD) lead for science and technology in the areas of survivability and protective structures, airfields and pavements, and sustainment engineering. Consistently at the forefront of engineering and scientific research, GSL is a key component of the worldwide recognition ERDC achieves, most recently as the Army Large Research Organization of the Year.

Capabilities

The GSL mission focuses on military engineering to develop innovative technologies for survivability and protective structures, force projection, and maneuver support and on civil works engineering to support water-resource infrastructure and geosciences. GSL operates a number of unique laboratory and research facilities, including the TeleEngineering Operations Center, or TEOC; the world's most powerful centrifuge dedicated to engineering and scientific research; and the DoD's lead pavements research facility for roadways, permanent and contingency airfields, and railroads.

Research conducted in GSL's nine branches encompasses the areas of soil mechanics, engineering geology, near-surface geophysics, earthquake engineering, pavements (both expedient and permanent), mobility and traffiability of military vehicles; weapons effects and blast mitigation, structural design and performance of structures under both static and dynamic loadings, earth dynamics, and the uses and performance of concrete, cement, and other construction materials. Other investigations include measurement and analysis of seismic and acoustic signals to locate airborne and ground military targets and buried objects and to characterize earth media. Research on concrete and cement relates predominantly to currently recognized military and civil needs. Structures research involves development, testing, and evaluation of a broad class of structures to resist the effects of static and dynamic loads induced by earthquakes and other sources. Research in numerical modeling and computer simulation of many of these topics is also undertaken.

Point of Contact

Dr. David W. Pittman, Director, Geotechnical and Structures Laboratory
US Army Engineer Research and Development Center
601-634-3304, David.W.Pittman@erdc.usace.army.mil
History of the Vicksburg Campaign of the Civil War

Vicksburg and the surrounding area was a highly coveted strategic position during the Civil War, due to its many natural and manmade converging points. The Yazoo River connects with the Mississippi River at this point, as well as the railroads east and west of the Mississippi which meet at the ferry crossing. Perhaps even more important was the city’s position on the Mississippi River, located on heights overlooking a sharp bend in the river where all river traffic must slow to pass. Confederate fortifications and guns emplaced on this naturally defensive position dominated the river and any immediate approach to the city. As long as the Confederates held Vicksburg they could move men and material from the western regions of the Confederacy to the east, and interfere with all traffic on the major river.

1863 Map of Vicksburg Area

The topography and terrain of the Vicksburg area made it an area of both strategic and tactical importance to the forces contesting control of the city. Guns mounted in fortifications on the heights dominated the river approaches, and naturally convoluted hills, ravines, creeks, and lakes surrounding Vicksburg on the landward side provided excellent sites for defense. The loess formations covering the landscape formed vertical cliffs, providing the defending Confederates with nearly impassable points of tactical defense.

The terrain surrounding the Mississippi and Yazoo rivers featured swamps, bayous, creeks, and horeshoe oxbow lakes formed by past movements and changing courses of the rivers. Grant’s army had to maneuver from its position on the west side of the Mississippi through this terrain to assault Vicksburg from any direction, and mud, tree filled bayous, endless swamps, and obstacles of Confederates prodiced tremendous challenges to maneuver. Overcoming or enhancing the terrain occupied both sides of the conflict with massive engineering challenges. While the Confederates constructed earthwork fortifications on the naturally defensive terrain in the Vicksburg area, Union troops labored in overcoming the obstacles swamp and bayou presented.

By December 1862 the forces of the Union Army of the Tennessee were in motion on the campaign to take Vicksburg from the Confederates. In 1862 U.S. president Abraham Lincoln made Ulysses S. Grant commander of the armies of the Western theater, following Grant’s...
victories in Kentucky and Tennessee which took control of the Ohio River from the Confederates. Other victories north and south of Vicksburg at Memphis and New Orleans gave control of the Mississippi River to the Union with the exception of Vicksburg, Mississippi and Port Hudson, Louisiana.

Confederate president Jefferson Davis gave command of the defense of Vicksburg to John C. Pemberton, ironically a native of Pennsylvania, a Union state. Davis also put Joseph E. Johnston in command of the Confederate armies of the West, but did not directly place Pemberton or his forces under Johnston’s command. The choice of commanders on both sides would shape the events of the campaign. Johnston's obstinence, Pemberton's indecisiveness, and the lack of coordination between the two generals would plague the Confederates throughout the campaign. Conversely, Grant's planning, flexibility, and cooperation with his generals and the Navy would serve to win him and the Union Vicksburg, the last Confederate stronghold on the Mississippi.

Initially intending to take Vicksburg over a conventional overland route, Grant marched from Tennessee into Mississippi via Holly Springs, Corinth, and Oxford. Grant was in position at Grenada, facing Confederate forces across the natural defensive position of the Tallahachie River, when Confederate cavalry attacked and captured his supply base at Holly Springs. This action forced Grant to retreat to Memphis where he could embark his armies on transports and attack Vicksburg from the river route. Grant had already sent part of his force downriver with William T. Sherman, to storm the Chickasaw Bluffs directly at Vicksburg. Sherman was supposed to be supported by Grant, who was retreating, and this first assault ended in disaster. Grant and his generals then undertook a series of attempts to maneuver their gunboats and transports around the guns and heights of Vicksburg.

One of the most grandiose and impractical attempts to outflank the defenses of Vicksburg was Steele's Bayou expedition, in which Union gunboats and transports were supposed to navigate a route through 700 miles of bayou, swamp, and flooded land to reach the Yazoo River and navigate it to a landing just a few miles south of where it began. This attempt failed not only because the natural waterways were impassable, but also because of the efforts of Confederates to fell trees in the water and construct fortifications which stopped the
Union advance. Grant’s other major attempt involved the continuation of a canal, begun in 1862, which was supposed to cut through the Desoto point peninsula directly opposite Vicksburg on the west bank. The canal was designed to allow Grant’s transports and gunboats to bypass the guns at Vicksburg, but the emplacement of Confederate guns at the exit of the canal doomed this scheme to failure.

Grant eventually found a way south of Vicksburg, with his transports navigating through bayous on the Louisiana side, and his heavier gunboats running the gauntlet of the Vicksburg defenses directly down the Mississippi. After an abortive attempt to cross the Mississippi at Grand Gulf on April 29, 1863, where Confederate guns kept the Union fleet at bay, Grant crossed further south at Bruinsburg. Marching inland, Grant’s army brushed aside minor resistance from small Confederate units dispersed by Pemberton at Port Gibson and Raymond. Union forces marched on in the spring rains to take the state capitol, Jackson on May 14. Two days later Union and Confederate forces would meet at Champion’s Hill, an obscure height between Vicksburg and Jackson.

Pemberton’s Confederate forces had marched out of Vicksburg and expected to link up with Gen. Johnston in order to defeat the numerically superior Union forces. Much to Pemberton’s disappointment, Johnston had vacillated, stalled, and remained idle in reinforcing Pemberton until it was too late. Overwhelming Union force won the engagement after initial Confederate successes, and drove the Confederates to guard their retreat to Vicksburg at the battle of the Big Black River on May 17.

Intending to further his success against a demoralized enemy, Grant immediately ordered an assault on the Stockade Redan fortification of the Vicksburg defenses on May 19. This assault and a larger one on May 22nd both ended in a failure to gain ground and disastrous casualties. Grant was forced to conclude that a siege of the city would have to be undertaken, and Union forces began constructing gun emplacements to bombard the defenses, sap trenches that zigzagged towards enemy lines, and mines that tunneled underneath strong points which were packed with explosives and detonated with gruesome effect.

Surrounded by Union gunboats on the river to the west, and Grant’s army to the north, east, and south, the citizens of Vicksburg and its garrison were worn down by starvation, bombardment, and disease. For 47 days the citizens and soldiers in Vicksburg were forced to eat horse meat, peabread, and anything they could find while being shelled day and night, preventing any rest. When Pemberton asked his generals if they could break out, they unanimously replied they couldn’t due to the poor state of their troops.
Pemberton arranged to meet Grant between the lines on July 3, 1863, to discuss terms of surrender. Grant stated that only unconditional surrender was acceptable, and Pemberton almost left the proceedings in indignation. Fortunately for the thousands more that would have died if the siege continued, an adjutant intervened and Pemberton surrendered. On July 4, 1863, Independence Day, Grant’s forces marched into Vicksburg victorious. Grant’s victory at Vicksburg revealed his abilities as an exceptional commander, with Lincoln giving him command of all the Union armies in 1864. Grant would accept Robert E. Lee’s surrender of all Confederate forces in 1865, and go on to be elected President of the United States.

**Vicksburg National Military Park**

The Vicksburg National Military Park spans an area of northeast Vicksburg and includes many of the crucial points on the battlefield contested by Union and Confederate forces during the 47 day siege over Vicksburg during the Civil War. The park includes a Visitor center, 26 State Memorials, Individual Statues of key figures, the ironclad union gunboat USS Cairo exhibit and museum, the Vicksburg National Cemetery, and other marked key sites, siege works, and artillery. The park is open 8-5 daily and is open to the public for driving or walking tours. The Visitors Center includes a museum describing the siege and gift shop. Outside the visitor’s center is a reconstructed Confederate gun emplacement and several types of cannon used in the siege are on display.

The park drive begins at the Memorial Arch, then makes a loop which includes Union Avenue and Confederate Avenue. Most of the Memorials, donated by their respective state governments, were completed in the early 1900’s at the Park’s opening, but more recent dedications have been emplaced, such as the African American monument for the 1st and 7th Mississippi regiments, dedicated to black soldiers fighting for the Union.

Union Ave. winds through the former Union siege lines with monuments and memorials dedicated to Union states that participated in the battle. Batteries of cannon are placed in their original siege redoubts, such as DeGoyler’s battery. These guns and hundreds of others like them were emplaced in earthen fortifications by both sides and served in reducing fortifications and harassing the enemy. The extreme terrain, including steep loess cliffs that were very influential in the battle, remains much as is was in 1863, and many of the man-made modifications remain visible.

The Illinois memorial is particularly conspicuous with its Greco-Roman classical Basilica shape and its white marble dome. Nearby is the Shirley House, a Civil War era structure, home to a family of Northern Sympathizers and the headquarters of an Iowa regiment besieging Vicksburg. Across from the Shirley House is the 3rd Louisiana Redan, a Confederate fortification that was constantly pounded by the Union artillery, but which resisted all assaults upon it. In the northeast corner of the park stands the U.S. Grant statue, monument to the Union commander, conqueror of Vicksburg, and eventual President of the United States.
The end of Union Avenue brings visitors to the USS Cairo Museum, which exhibits the Union ironclad USS Cairo and other artifacts associated with the naval aspects of the campaign. The Cairo was sunk by a Confederate underwater mine, then called a "torpedo", near Vicksburg in 1863. The vessel was later raised from the river bottom in the 1960's and restored by the park as an exhibit and memorial. This vessel and others like it represented the best naval technology and engineering of the time, and comprised the fleet commanded by Union Adm. David D. Porter which bombarded the defenses of Vicksburg. The vessel itself can be walked through, with the cannon, armor, smoke stacks and steam boiler visible. The irony of the vessel’s demise is that this top class innovative warship was destroyed by an electronically controlled underwater mine, itself a new innovation in defensive military engineering.

Overlooking the Yazoo River, which now runs where the Mississippi River ran in 1863, is The Vicksburg National Cemetery. Established in 1866, the cemetery is the hallowed ground where over 17,000 Union soldiers and sailors rest forever, who perished from disease and battle during the Vicksburg siege. Over 13,000 of the graves are unmarked, soldiers whose names are lost forever, but whose service to their nation can never be questioned. The graves of the thousands of Confederate dead are buried in Vicksburg's Cedar Hill cemetery and other sites.

Confederate Avenue travels the west side of the park and includes many of the sites of heavy fighting where Confederate fortifications were located during the siege such as Fort Hill, the Stockade Redan, the 3d Louisiana Redan, the Great Redoubt, and the 2nd Texas Lunette. Near the end of Confederate Ave. stands the Mississippi memorial, a striking monument with its granite obelisk standing 76 ft. high. Around its base an impressive bronze sculpture encases the monument, with Confederate soldiers extending outside the confines of the space. A large portion of Pemberton's Confederate force holding Vicksburg were Mississippians, who had all the more reason to defend this strategic location in their home state.
Tinsley Oil Field is the first and most famous oil field in Mississippi. Tinsley field is located in west-central Mississippi about 35 miles northwest of Jackson in the loess hills of rural Yazoo County. The oil field is on the northern flank of the Mississippi Salt Basin (Figure 1).

Tinsley Dome was discovered by former state geologist Frederic Francis Mellen in 1939, during a routine mineral survey of Yazoo County. He found a small exposure of marl, a bed believed to be a reliable stratigraphic marker, in a creek bed at an elevation much higher than its “normal” position. After gathering detailed surface geological field data to contour his maps, Fred realized his contours formed a closure around Tinsley. He had discovered a dome structure favorable for oil and gas accumulation that sparked immediate exploration and would later become the giant Tinsley Oil Field (Cockrell, 2005; Mellen, 1940).

Tinsley is one of the largest oil fields in the state and produces from multiple reservoirs. The top of a giant mound of salt lies buried more than 11,000 feet deep beneath the rugged hilly terrain of Yazoo County. A broad faulted anticline was formed in the overlying sediments due to upward pressure of the salt. In addition to the oil accumulations formed in the peaks of the folded layers overlying the salt dome, dozens of separate oil pools occurred within the same layers on the sides of the anticline as a result of faulting (Cockrell, 2005).

Very little time had passed between the discovery of the Tinsley Dome and the arrival of the first rig. No rigs were available in Mississippi, so one had to be trucked in from Louisiana. The rig would have normally come by rail, but the rail siding at Tinsley had been removed just a few months prior and there was no place to unload. The trucks attempting to carry the rig were arrested on Highway 3 just outside of Tinsley for illegal overloading and charged with a $500 fine.

Fig. 1. Major subsurface geologic features of Mississippi
The first commercial oil well in Mississippi was Union Producing Company G.C. Woodruff No. 1 well (Figure 2). The discovery well hit oil on August 29, 1939 and was completed in September at 4,560 feet in an Upper Cretaceous “Woodruff” sand. Oil and/or gas bearing formations include the Smackover, Hosston, Rodessa, Mooringsport, Paluxy, Tuscaloosa, Eutaw, Selma, Wilcox, and Claiborne Group (Figure 3). Large faults divide the field into three distinct producing segments shown in the structure contour of the top of the “Woodruff” zone (Figure 4).

News of the oil discovery in Mississippi resonated through the industry. People poured in from all over the country hoping to lease nearby land. The discovery of the Tinsley Dome led to extensive economic development. The availability of Tinsley crude gave rise to several new refineries in the area, creating competition for nearby large refineries in Louisiana.

The Mississippi Geological Society was founded on November 28, 1939 in response to the significant oil and gas discovery of large oil reserves in Tinsley Field. The Society was organized with the stated purpose of "the stimulation of interest in geology and related sciences..., the encouragement of scientific research among members..., and the discussion and dissemination of geological information"(King). Frederic Mellen served as president of the Mississippi Geological Society from 1946-1947.

Alan Cockrell comments on Frederick Mellen’s character in his book, Drilling Ahead (2005), “Fred had found the Tinsley Dome doing taxpayer-funded work and in his mind the citizens owned the information. He didn’t rush out to buy oil leases. He rushed to his typewriter. Those who had the privilege of knowing him in the years to come would marvel at his unassuming honesty and unwavering integrity.”
Denbury Resources Inc. acquired Tinsley Oil Field in 2006, which has become the company’s highest valued field. Denbury is experimenting with carbon dioxide (CO2) enhanced oil recovery to increase oil production. This improved extraction process involves injection of CO2 through wells into the reservoir. The CO2 expands and increases the reservoir pressure causing oil to rise to the surface. The CO2 dissolves in the oil, decreasing the viscosity and increasing the oil’s flow rate. The supply of CO2 at Tinsley is transported from the natural Jackson Dome source as a compressed liquid via pipeline for injection at approximately 11,000 ft depth into the Cretaceous reservoirs (Denbury, 2007).

The Jackson Dome is the dominant structural feature of central Mississippi and was formed as an igneous intrusion in the Late Cretaceous. Carbon dioxide from the volcanic eruption was trapped in the surrounding rocks which formed the natural CO2 reserves used today in enhanced oil recovery. The CO2 is found in the Upper Jurassic Smackover shallow water carbonate reservoirs along the northeast flank of the Jackson Dome. After the eruption of Jackson Dome, the volcano was eroded and formed a large area of sandbars and beaches along the shallow sea. Some of this sand became the Woodruff sandstone, which is the main producing reservoir at Tinsley Field (Denbury, 2007).
Mississippi’s second commercial oil well, Union Producing Company Perry Estate N.1, at Tinsley Field. (Photographed by William Morse on 9-22-1939)

Tinsley has produced 240+ million barrels of oil and is predicted to keep producing in the future with the use of CO2 enhanced oil recovery technology. The discovery of the Tinsley Oil Field in 1939 is considered to be the most significant event to occur in the history of petroleum in the southeastern states. The Mississippi River barrier had been broken once and for all.
Fig. 4. Structure map contoured on the top of the "Woodruff" Upper Cretaceous zone, 50 ft. contour interval, and sections are 1 mile on a side. Original oil-water contact was at approximate elevation of -4700 feet.
The Crown Restaurant in Indianola, MS has been serving its signature foods for 32 years, and is home of the Taste of Gourmet direct sale food company. The Crown has gained notoriety with appearances on the Food Network, Turner South, Southern Living, CNN, Travel Channel, and Bon Appetit. The Crown’s signature catfish is anything but fried, and its colorful cuisine is mirrored in its vibrant atmosphere, with local folk art and antiques on sale as well as its renowned food. A book store and toy store are available as well as pottery and jewelry. Indianola’s secret lunch spot is now a must for anyone dining in the Delta.
Red Hills Mine is an open pit lignite mining operation in northeast Mississippi near the town of Ackerman in Choctaw County. The mine produces approximately 3.6 million tons of lignite annually to the adjoining ten-story Red Hills Power Plant.

Red Hills Mine is owned and operated by the Mississippi Lignite Mining Company (MLMC). MLMC is an affiliate of The North American Coal Corporation, the largest producer of lignite in the United States.

The Red Hills power facility uses clean coal technology that burns lignite coal to generate 440 megawatts of electricity supplied to the Tennessee Valley Authority (TVA). The power plant is owned and operated by Choctaw Generation LLP, an affiliate of Tractebel Electricity and Gas International.

Lignite is a soft brownish-black coal used almost exclusively for electric power generation. Lignite has a carbon content between peat and bituminous coal and often retains the texture of wood from which it was formed. The lignite seams at Red Hills Mine were formed in fluvial environments in which several sequences of flooding and stream channel migration occurred. During these swamplike conditions, thick accumulations of organic matter were deposited, which was buried and compressed overtime into lignite. Geologists estimate that it takes 16 feet of organic matter to create one inch of lignite.
The coal seams mined at Red Hills are within the Wilcox Group Formation, which formed about 57 million years ago. Ten major lignite seams have been mapped within the mining area, but only six relatively continuous seams are being mined. The mined coal seams vary in thickness from two to six feet. Depth to the deepest mined lignite seam averages at 200 feet. The Lower Wilcox Aquifer is not impacted by the mining operations since it is over 100 feet below the lowest mined lignite seam.

Mining involves the removal of six lignite seams uncovered by continuous removal of overlying materials. Truck and shovel operations remove the plant growth and overburden materials to the first lignite seam. Caterpillar D-11 class dozers sequentially uncover the next three seams by pushing overburden into a preceding pit. A Marion 8200 electric dragline known as the “Steel Magnolia”, equipped with an 82 cubic yard bucket is used to uncover the last two lignite seams. The dragline operates on 23,000 volts of electricity, weighs 8 million pounds, and has a boom 325 feet long. As the lignite seams are exposed they are recovered with a 22 cubic yard bucket excavator, a 40 cubic yard loading shovel, and an Easi-Miner used to load 165-ton end dump trucks for delivery.

The first lignite mined from Red Hills was in December 1999. 10,000 tons of lignite coal is delivered to the power station per a day from the 8,000 feet long, 1,500 feet wide, and 250 feet deep surface pit. Average lignite quality at Red Hills is 5120 BTU/lb, 43.09% moisture, 14.40% ash.

The power plant generates 440 megawatts of electricity using modern circulating fluidized bed (CFB) boiler technology. Fuel conversion produces 670,000 tons of dry CFB ash annually, which is disposed of in lined permitted disposal cells adjacent to the power plant. The CFB boilers have significant benefits over typically used pulverized coal boilers (PCB). PCBs combust coal at approximately 3,000o F, whereas CFBs combust a mixture of coal and limestone at about 1,400o F. CFB boilers capture and bind sulfur and lime into calcium sulfate and reduce nitrogen oxides.
Mine production is impacted greatly by the haul road conditions since they must support haulage trucks weighing 550,000 pounds and carrying 150 ton payloads at speeds up to 34 mph. Use of CFB ash as a mine road building material not only has improved haulage production, reduced diesel fuel consumption and emissions, and reduced road maintenance, but also conserves natural aggregates from quarries and lengthens the life span of primary ash disposal facility.

The predominant pre and post mine land use is commercial forest. The mining site is characterized as wooded, rural countryside with occasional pasturelands, ponds, and sparse residential development. Terrain is gently rolling with wide valleys, small streams and dissected uplands.

Reclamation involves grading and contouring in order to return the terrain to its original landscape. The reclaimed area is first covered with plant growth material, then seeded with grass cover for erosion control, followed by the planting of pine tree seedlings. Over 200,000 trees have been planted as part of the Red Hills Mine reclamation process.

The mine manages reclaimed land until it can be returned to the owner, which requires at least five years after mining and reclamation is complete. Most of the mined land is being restored to loblolly pine forest. Drainage bottoms are reclaimed to include hardwoods, enhanced stream channels, and small wetlands and ponds important for local fish and wildlife resources. A 75-acre recreational fishing lake was constructed by the mine reclamation and stocked with bass, bream, catfish, and crappie.

Lignite reserves in Mississippi were estimated by the MS Geological Survey to be 8.0 billion tons, with over 200 million tons of mineable lignite within the Red Hills Mine permitted area of 5,800 acres.
References

Sardis Lake Dam

Blues Highway

ERDC
Engineer Research and Development Center (ERDC), <http://gsl.erdc.usace.army.mil/gsl.html>.

Vicksburg Military Park
Ambrose, S., 1967, Struggle For Vicksburg: The Battles and Siege That Decided the Civil War: Gettysburg, Historical Times Inc.

Tinsley Oil Field

Red Hills Mine
Hawkey, George M., and Merino, Marcelo P., 2005, Beneficial applications of circulating fluidized bed ash at Mississippi Lignite Mining Company’s Red Hills Mine.
Northway, Wally, 2006, Choctaw County powering up with energy industry: The Mississippi Business Journal (Monday, June 12, 2006).