Harnessing the Mississippi River and Delta: The Natural System, Infrastructure, Risks and Impact

University of Notre Dame Civil Engineering Junior Class
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Fast Field Trip Facts

Mississippi River

- The Mississippi River drains approximately 41% of the United States in the region extending from the continental divide in the Rocky Mountains to the Appalachian Mountains and from just south of the Great Lakes to the Gulf of Mexico.
- It is the third largest river in the world. The flow ranges from an average low summertime flow of approximately 240,000 cfs to high flows of up to 3,000,000 cfs.
- Most of the water that falls within this catchment region drains through the Mississippi River. Water reaches the tributary and river system as either overland flow or base flow fed through the groundwater system. Some of the water that infiltrates into the vadose zone is evapotransporated into the atmosphere.
- With the development of urban areas and farm lands, the drainage paths to the river have been made increasingly impervious and efficient. Man made roofs, roads, combined and storm sewers, and well drained farmlands result in more flow to the river getting there faster. Note that for the primal forest and prairie coverage, greater surface roughness and surface perviousness led to slower overland flow and greater infiltration, decreasing peak flows and leading to a steadier and slower groundwater release.
- Erosion of mountains results in sediments that eventually are carried by streams and rivers and deposit into the Gulf of Mexico.
- The Mississippi River and its major tributaries have provided a transportation system throughout the United States for centuries. Even today river shipping remains the most economical and efficient mode of transportation for bulk commodities. For the system to be vital and efficient, it is critical that there is an efficient link between deep draft ocean going vessels and shallow draft river boats.

From Wikipedia, the free encyclopedia

The **Mississippi River**, derived from the old Ojibwe word *misi-ziibi* meaning 'great river' (*gichi-ziibi* 'big river' at its headwaters), is the second-longest river in the United States; the longest is the Missouri River, which flows into the Mississippi.[4] Taken together, they form the largest river system in North America. If measured from the head of the Missouri, the length of the Missouri-Mississippi combination is approximately 3,900 miles (6,300 km), making the combination the 4th longest river in the world. Apart from the Missouri, the largest of the many large Mississippi tributaries is the Ohio River.

The source of the Mississippi River on the edge of Lake Itasca

With its source Lake Itasca at 1,475 feet (450 m) above sea level in Itasca State Park located in Clearwater County, Minnesota, the river falls to 725 feet (220 m) just below Saint Anthony Falls in Minneapolis. The Mississippi is joined by the Illinois River and the Missouri River near St. Louis, Missouri, and by the Ohio River at Cairo, Illinois. The Arkansas River joins the Mississippi in the state of Arkansas. The Atchafalaya River in Louisiana is a major distributary of the Mississippi.

The Mississippi drains most of the area between the Rocky Mountains and the Appalachian Mountains, except for the areas drained by the Great Lakes and the Rio Grande. It runs through two states — Minnesota and Louisiana — and was used to define the borders of eight states (the river has since shifted) — Wisconsin, Iowa, Illinois, Missouri, Kentucky, Arkansas, Tennessee, and Mississippi — before emptying into the Gulf of Mexico about 100 miles (160 km) downstream from New Orleans. Measurements of the length of the Mississippi from Lake Itasca to the Gulf of Mexico vary, but the EPA's number is 2,320 miles (3,733 km). The retention time from Lake Itasca to the Gulf is about 90 days.[5]

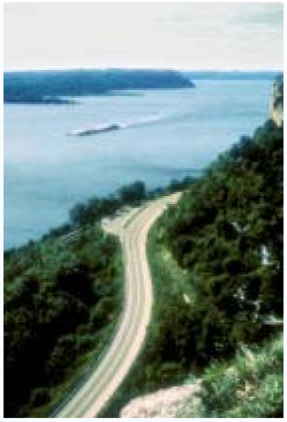
Confluence of the Mississippi and Ohio Rivers at Cairo, Illinois.

The river is divided into the upper Mississippi, from its source south to the Ohio River, and the lower Mississippi, from the Ohio to its mouth near New Orleans. The upper Mississippi is further divided into three sections: the headwaters, from the source to Saint Anthony Falls; a series of man-made lakes between Minneapolis and St. Louis, Missouri; and the middle Mississippi, a relatively free-flowing river downstream of the confluence with the Missouri River at St. Louis.

A series of 29 locks and dams on the upper Mississippi, most of which were built in the 1930s, is designed primarily to maintain a 9 foot (2.7 m) deep channel for commercial barge traffic.[6][7] The lakes formed are also used for recreational boating and fishing. The dams make the river deeper and wider but do not stop it. No flood control is intended. During periods of high flow, the gates, some of which are submersible, are completely opened and the dams simply cease to function. Below St. Louis, the Mississippi is relatively free-flowing, although it is constrained by numerous levees and directed by numerous wing dams.

Through a natural process known as deltaic switching the lower Mississippi River has shifted its final course to the ocean every thousand years or so. This occurs because the deposits of silt and sediment raise the river's level causing it to eventually find a steeper route to the Gulf of Mexico. The abandoned distributary diminishes in volume and forms what are known as bayous. This process has, over the past 5,000 years, caused the coastline of south Louisiana to advance toward the Gulf from 15 to 50 miles (25-80 km).

U.S. government scientists determined in the 1950s that the Mississippi River was starting to switch to the Atchafalaya River channel because of its much steeper path to the Gulf of Mexico, and eventually the Atchafalaya River would capture the Mississippi River and become its main channel to the Gulf of Mexico. As a result, the U.S. Congress authorized a project called the Old River Control Structure, which has prevented the Mississippi River from leaving its current channel that drains into the Gulf via New Orleans. Because of the large scale of high energy water flow through the Old River Control Structure threatening to damage the structure, an auxiliary flow control station was built adjacent to the standing control station. This US$300 million project was completed in 1996 by the Army Corp of Engineers.



Looking down on the [Great River Road]() in Wisconsin, with Minnesota in the distance across the Mississippi River

Course changes

The [Illinoian Glacier](), about 200,000 to 125,000 years before present, blocked the Mississippi near [Rock Island](), diverting it to its present channel farther to the west (current western border of Illinois). The [Hennepin Canal]() roughly follows the ancient channel of the Mississippi downstream from Rock Island to Hennepin. South of [Hennepin](), the current [Illinois River]() is actually following the ancient channel of the Mississippi River to [Alton]() before the Illinoian glaciation.

Other changes in the course of the river have occurred because of [earthquakes]() along the [New Madrid Fault Zone](), which lies near the cities of [Memphis]() and St. Louis. Three earthquakes in 1811 and 1812, estimated at approximately 8 on the [Richter Scale](), were said to have temporarily reversed the course of the Mississippi. These earthquakes also created [Reelfoot Lake]() in Tennessee from the altered landscape near the river. The faulting is related to an [aulacogen]() (geologic term for a failed rift) that formed at the same time as the Gulf of Mexico.

Mississippi Watershed

The Mississippi River has the third largest drainage basin ("catchment") in the world, exceeded in size only by the watersheds of the Amazon River and Congo River. It drains 41% of the 48 contiguous states of the United States. The basin covers more than 1,245,000 square miles (3,225,000 km²), including all or parts of 31 states and two Canadian provinces.

The Mississippi River Flood Control Project

From http://www.mvn.usace.army.mil/pao/bro/misstrib.htm

Without question America's greatest river, the Mississippi, has made major contributions to the physical and economic growth of the nation. It is a navigation artery of great importance to the nation's transportation system, carrying an ever-growing commerce. Coursing through the heart of America, it supplies water for the cities and industries that have located along its banks. More and more the Mississippi's importance is emphasized as America continues to grow. This great river is, truly, one of the Nation's outstanding assets. Uncontrolled, it would be just as great a liability.

The Mississippi River always has been a threat to the security of the valley through which it flows. Garciliaso de la Vega, in his history of the expedition begun by DeSoto, described the first recorded flood of the Mississippi as severe and of prolonged duration, beginning about March 10, 1543, and cresting about 40 days later. By the end of May the river had returned to its banks, having been in flood for about 80 days.

Since that time, explorers, traders, farmers, men of commerce, and engineers have known -- sometimes too well -- the Mississippi in flood.

The Mississippi Drainage Basin

The Mississippi River has the third largest drainage basin in the world, exceeded in size only by the watersheds of the Amazon and Congo Rivers. It drains 41 percent of the 48 contiguous states of the United States. The basin covers more than 1,245,000 square miles, includes all or parts of 31 states and two Canadian provinces, and roughly resembles a funnel which has its spout at the Gulf of Mexico. Waters from as far east as New York and as far west as Montana contribute to flows in the lower river. By the year 1879, the need for improvement of the Mississippi River had become widely recognized. The necessity for coordination of engineering operations through a centralized organization had finally been accepted.

Accordingly, in that year, the Congress established the Mississippi River Commission and assigned it the duties. . . " to take into consideration and mature such a plan or plans and estimates as will correct, permanently locate, and deepen the channel and protect the banks of the Mississippi River, improve and give safety and ease to navigation thereof, prevent destructive floods, promote and facilitate commerce, trade, and the postal service."

The Commission was to consist of three officers of the Corps of Engineers, one of whom would be President; one member from the U.S. Coast and Geodetic Survey; and three civilians, two of whom would be civil engineers. All appointments would be nominated by the President of the United States, subject to confirmation by the Senate.

In 1882, three years after establishment of the Commission, one of the most disastrous floods ever known devastated the entire delta area. The losses were appalling. During that flood there were hundreds of crevasses, and the outlook for a permanent solution to flooding in the Mississippi Valley was disheartening.

Major floods again occurred in 1912, 1913, and 1927. The flood of 1927 was the most disastrous in the history of the Lower Mississippi Valley. An area of about 26,000 square miles was inundated. Levees were breached, and cities, towns, and farms were laid waste. Crops were destroyed, and industries and transportation paralyzed.
Property damage amounted to about $1.5 billion at today's prices. Over 200 lives were lost and over 600,000 people displaced. Out of it grew the Flood Control Act of 1928, which committed the federal government to a definite program of flood control. This legislation authorized the Mississippi River and Tributaries (MR&T) Project, the nation's first comprehensive flood control and navigation act.

The Project Flood

The flood control plan is designed to control the "project flood." It is a flood larger than the record flood of 1927. At Cairo, the project flood is estimated at 2,360,000 cubic feet per second (cfs). The project flood is 11 percent greater than the flood of 1927 at the mouth of the Arkansas River and 29 percent greater at the latitude of Red River Landing, amounting to 3,030,000 cfs at that location, about 60 miles below Natchez.

Description of Plan

The four major elements of the Mississippi River and Tributaries Project are: ***levees*** for containing flood flows; ***floodways*** for the passage of excess flows past critical reaches of the Mississippi; ***channel improvement*** and ***stabilization*** for stabilizing the channel in order to provide an efficient navigation alignment, increase the flood-carrying capacity of the river, and for protection of the levees system; and ***tributary basin improvements*** for major drainage and for flood control, such as dams and reservoirs, pumping plants, auxillary channels, and the like.

Main Stem Levees

The Mississippi River levees are designed to protect the alluvial valley against the project flood by confining flow to the leveed channel, except where it enters the natural blackwater areas or is diverted purposely into the floodway areas.

The main stem levee system, comprised of levees, floodwalls, and various control structures, is 2,203 miles long. Some 1,607 miles lie along the Mississippi River itself and 596 miles lie along the south banks of the Arkansas and Red rivers and in the Atchafalaya Basin.

The levees are constructed by the federal government and are maintained by local interests, except for government assistance as necessary during major floods. Periodic inspections of maintenance are made by personnel from the U.S. Army Corps of Engineers and from local levee and drainage districts as it is essential that the levees be maintained in good condition for their proper functioning in the flood control plan.

Floodways

From Cairo to New Madrid, Mo., the east bank bluffs and the levee as originally built on the west bank left only a narrow channel through which the river could flow at flood stage. To protect communities along the Mississippi and Ohio rivers and to reduce the flood heights to which the controlling levees on the Missouri side would otherwise be subjected, the project provides for a setback levee about 5 miles west of the riverfront levee through this reach. The strip between this setback levee and the levee adjacent to the river forms what is known as the Birds Point-New Madrid Floodway, operated only at extremely high stages. Water enters the floodway through lower levee sections or "fuse plugs" in the old front levee below Cairo and reenters the main river just above New Madrid. The floodway was operated in 1937 and was of material aid in reducing flood heights at and above Cairo.

At the latitude of Red River Landing, the project flood is estimated at 3,000,000 cfs. The project provides for dividing this great quantity of water, with 1,500,000 cfs of the flow continuing down the main river channel, the remaining 1,500,000 cfs being diverted to the Atchafalaya River via the Morganza and West Atchafalaya floodways, and the Old River Control structures.

Of the 1,500,000 cfs flowing down the main channel below Morganza Floodway, 250,000 cfs are to be diverted to Lake Pontchartrain and the Gulf through the Bonnet Carre' Spillway, located about 25 miles above New Orleans. The remaining 1,250,000 cfs will continue down the river to the Gulf.

That portion of the flow diverted from the main channel near Old River is carried by the Atchafalaya River, the Morganza Floodway, and the West Atchafalaya Floodway. The Morganza and the West Atchafalaya floodways follow down on opposite sides of the Atchafalaya River until the end of the levee system along the Atchafalaya River is reached; there they merge into a single broad floodway that passes the flow to the Gulf through two outlets, Wax Lake and Berwick Bay. In major floods, the Morganza would be the first of these two floodways to be used, with water entering it through a control structure just above Morganza.

Channel Improvement and Stabilization

Stabilization and protection of the riverbanks are important to the flood control and navigation plan, serving to protect flood control features and to insure the desired alignment of the river's navigation channel. This is accomplished by:

Cutoffs	Shortening the river and reduce flood heights.
Revetment	Controlling the river's meandering.
Dikes	Directing the flow.
Improvement Dredging	Realigning the channel.

Principal Tributary Basin Improvements

The Flood Control Act of 1928 authorized work that would give the various basins protection against Mississippi River floods only, although the tributary streams within the basins caused frequent flood damage that could not be prevented by the main stem Mississippi River protective works. Later amendments to this act have authorized work that provides alleviation of the tributary flood problems.

There are four major drainage basins in the lower Mississippi River Valley Project: St. Francis in east Arkansas; Yazoo in northwest Mississippi; Tensas in northeast Louisiana; and Atchafalaya in south Louisiana. There are five flood control reservoirs in the tributary basin improvement plan: Wappapello Lake in the St. Francis Basin, and four lakes -- Arkabutla, Sardis, Enid, and Grenada -- in the Yazoo Basin.

Old River Control

One of the most important modifications to the project was made in 1954 when Congress authorized the feature for the control of flow at Old River to prevent the capture of the Mississippi by the Atchafalaya River.

The first two features completed were the low-sill and overbank structures, the former to pass low and medium flows from the Mississippi to the Atchafalaya River in a controlled manner, and the latter to pass flood flows to the Atchafalaya in conformance with the flood control plan. Inflow and outflow channels were constructed connecting the low-sill structure with the Mississippi and Red-Atchafalaya rivers. A third facility -- called the Auxillary Structure -- was placed in service late in 1986.

As the closure of Old River would cut off an important shallow-draft navigation artery, a navigation lock was constructed just south of the junction of the Old and Mississippi rivers. This navigation lock is one of the most modern in the nation's inland waterway system. Channels were dredged connecting the lock to the Mississippi and Old rivers, and this feature was opened to navigation in 1963.

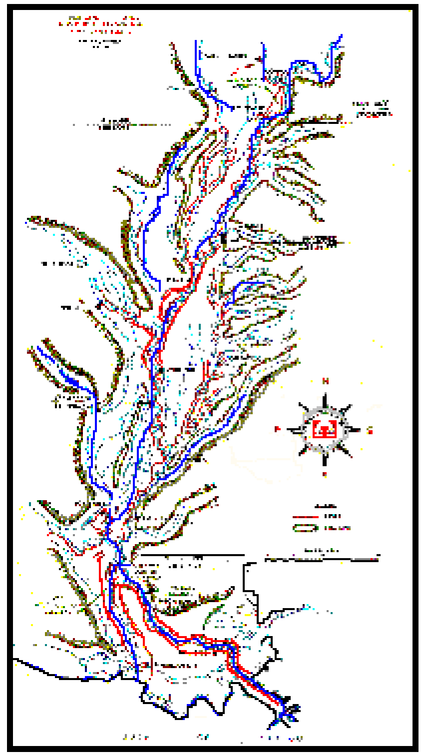
Navigation

No river has played a greater part in the development and expansion of America than the Mississippi. In 1705 the first cargo was floated down the river from the Indian country around Wabash, now the states of Indiana and Ohio. This was a load of 15,000 bear and deer hides brought downstream for shipment to France.

Invention of the steamboat in the early nineteenth century brought about a revolution in river commerce. The first steamboat to travel the Mississippi was the "New Orleans."

The Mississippi River is the main stem of a network of inland navigable waterways which form a system of about 12,350 miles in length, not including the Gulf Intracoastal Waterway of 1,173 miles.

Waterborne commerce on the Mississippi rose from 30 million tons in 1940 to almost 400 million in 1984. This heavy commercial traffic includes grains, coal and coke, petroleum products, sand and gravel, salt, sulphur and chemicals, and building materials among others. In addition, many pleasure craft from all parts of the country now use the Mississippi for vacation and travel.



The MR&C Project Area.

The Mississippi River Delta

- Sediments are carried by the fast currents of the rivers towards the ocean. The faster the flow, the larger the sediment grain sizes that can be carried and the greater the total sediment load.
- High river flows carry the most sediment.
- Slow flows deposit the sediments that are being carried.
- When riverine flows reach the ocean, the flow spreads laterally, current speeds dramatically decrease, and the flow can no longer sustain the sediment load resulting in deposition of the sediments. A feature called a shoal forms. This is a round hill at the mouth of the river. The shoal is often redistributed by wave action into a fan like shape.

- Thus deltas form by the deposition of continental sediments into the ocean on the continental shelf (0 to 200 m deep) and continental slope (200 to 5000m) due to the slowing current speeds. The deltas build out further onto the shelf actually leading to a longer river channel that has to overcome more frictional resistance.
- Large flow events in the river which also carry the most sediment, can cause the flow to overtop the river channel and flood the surrounding region. Once the flow is no longer constrained by the channel, it slows and the sediments that are contained in the flow are deposited. These deposits form the naturally high areas adjacent to the rivers called channel banks.
- In response to the sediment deposition over the delta, the continental shelf/plates, sink deeper into the earth's magna layer. In addition natural compaction of the combined sediment and riverine detritus occur. Note that there is a layer of riverine sediments more than 8 km deep under New Orleans! (This is as deep as the deepest subduction zones in the ocean.) Thus areas that are not being nourished at any time in the delta system through lateral overflow or end river overflow tend to subside.
- Eventually, the lengthening of the river and the subsidence in adjacent regions allows the river to slowly find other more efficient paths to the ocean, first by forming distributaries, one of which will eventually take over as the main channel.
- The Mississippi River has moved like a fan throughout Southern Louisiana, spreading sediment from Texas to the eastern boundaries of the state. The river tends to shift course every 1000 years. Its current position has been in place for about that length of time. It has had courses through Lake Pontchartrain/Rigolets; ……..
- Topographic maps show high ground along both the current and ancient river locations from the banks that were formed through lateral sediment deposition occurring during bank overtopping events.

From Wikipedia, the free encyclopedia

The **Mississippi River Delta** is the modern area of land (the river delta) built up by alluvium deposited by the Mississippi River as it slows down and enters the Gulf of Mexico. The deltaic process has, over the past 5,000 years, caused the coastline of south Louisiana to advance gulfward from 15 to 50 miles (24 to 80 km).

It is a biologically significant region, comprising 3 million acres (12,000 km^2) of coastal wetlands and 40 % of the salt marsh in the contiguous United States. It is also a commercially significant region, supporting the economy of New Orleans with significant shipping traffic, providing 16 to 18 % of the US oil supply, and providing 16 % of the US's fisheries harvest, including shrimp, crabs, and crayfish.

Recent influences

Every thousand years or so, the Mississippi river has changed course. Each Mississippi River deltaic cycle was initiated by a gradual capture of the Mississippi River by a distributary which offered a shorter and steeper route to the Gulf of Mexico. After abandonment of an older delta lobe, which would cut off the primary supply of fresh water and sediment, an area would undergo compaction, subsidence, and erosion. The old delta lobe would begin to retreat as the gulf advanced, forming bayous, lakes, bays, and sounds.

750 years ago, the Mississippi abandoned its main course through the Lafourche Bayou and began flowing in the current direction to the area where New Orleans is located. 550 years ago, it began extending further out into the Gulf of Mexico.

In the last 100 years or so, the river has been diverting more of its flow to the Atchafalaya River, which branches off some 60 miles (95 km) northwest of New Orleans. In the 1950's, engineers observed that the Mississippi would soon abandon its current channel as the mainstream, and instead migrate to the Atchafalaya. Because there is a considerable amount of economic development along the current path of the Mississippi, and because extensive flooding and evacuation would occur in the new area, Congress instructed the Army Corps of Engineers to maintain the then-present 70% / 30% distribution of water between the Lower Mississippi and the Atchafalaya River channels respectively. They did so by building the Old River Control Structure which consisted of massive floodgates that could be opened and closed as needed at the entrance to the Old River.

Man-made changes to other parts of the Mississippi River have a pronounced effect on the Delta region. Dams, artificial channeling, and land conservation measures have caused a decrease in sediment carried into the delta region, decreasing the rate of build up of the Delta.

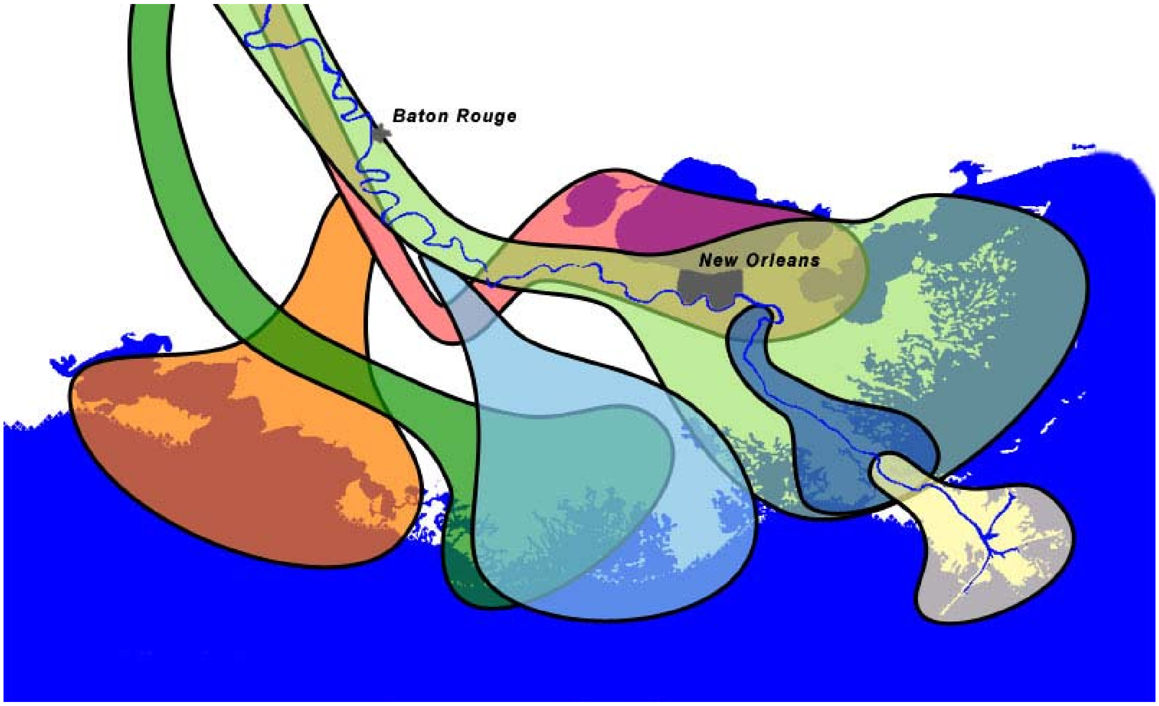
At the same time, the rate of loss of the Delta has recently increased past the rate of build up, causing a net loss of wetlands in the Delta area. The rise of the sea level has also caused increased erosion, as fresh water vegetation previously protecting against erosion dies due to the influx of salt water. Subsidence has increased.

History

Build-up of the Gulf of Mexico shoreline due to the outflow of the Mississippi River has been occurring in a periodic fashion since the late Jurassic period. This same process is responsible for build up of the larger Mississippi embayment, however the delta region is the most recent, ecologically distinct, portion.

The latest cycle of delta formation can be traced to the pleistocene epoch, when a large amount of ocean water was tied up in glaciers. The sea level was 300-400 feet (~100m) below present level, and causing the mouth of the Mississippi to be located further out into the Gulf of Mexico. 10,000 years ago, the glaciers began to melt, and the sea level began to rise. 5,000 - 6,000 years ago, the sea level stabilized, and formation of recognizable modern deltas began.

[Lake Pontchartrain] was formed during the evolution of two separate delta lobes. 4000-3800 years ago, the Cocodrie lobe expanded over the area where New Orleans presently resides, forming the lake's southern shore. 2800-2600 years ago, the St. Bernard lobe pushed forward and completed the lake's eastern shoreline. [1]



New Orleans

From Wikipedia, the free encyclopedia

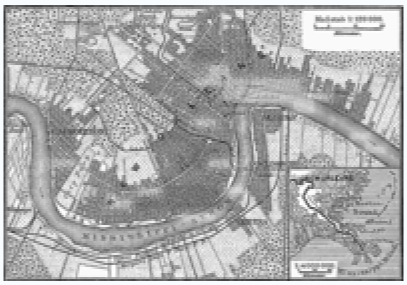
New Orleans was founded in 1718 by the French Mississippi Company as ***la Nouvelle-Orléans***, under the direction of Jean-Baptiste Le Moyne de Bienville. The site was selected because of its relatively high elevation along the flood-prone banks of the Lower Mississippi River and its location adjacent to a Native American trading route and portage between the river and Lake Pontchartrain.

In 1723, New Orleans became the third capital of French colonial Louisiana, following Biloxi (1720), and Mobile (1702).

In 1763, the French colony was ceded to the Spanish Empire and remained under Spanish control for 40 years. Most of the surviving architecture of the French Quarter dates from this Spanish period. Louisiana reverted to French control in 1801, but two years later Napoleon sold it to the United States in the Louisiana Purchase. The city grew rapidly, with influxes of Americans, French and Creole French.

During the War of 1812 the British sent a force to conquer the city. The British were defeated by American forces led by Andrew Jackson in the Battle of New Orleans on January 8, 1815. A peace treaty had been signed between the United States and Britain on December 24, 1814, but news of the treaty did not reach the United States in time to prevent the battle from occurring.

By 1840, New Orleans had become by far the wealthiest city in the nation, and was also ranked as the third most populous city, being beaten by Baltimore by only 119 people. Since that time, the city has become the thirteenth poorest large city in the Nation. Up until 1960 New Orleans had consistently been ranked in the top fifteen largest Cities in the U.S. but since that time, the city has shrunk to the thirty-fifth largest city in the U.S.



1888 German map of New Orleans

The population of the city doubled in the 1830s, and by 1840 the city's population was over 100,000—one of the largest cities in the U.S. Population growth was frequently interrupted by yellow fever epidemics, the last of which occurred in 1905.

As a principal port, New Orleans had a leading role in the slave trade, while at the same time having the most prosperous community of free persons of color in the South.[1][6] Early in the American Civil War New Orleans was captured by the Union. This action spared the city the destruction suffered by many other cities of the American South.

In the early 20th century, New Orleans was a progressive major city whose most portentous development was a drainage plan devised by engineer and inventor A. Baldwin Wood. Urban development theretofore was largely limited to higher ground along natural river levees and bayous. Wood's pump system allowed the city to expand into low-lying areas. Over the 20th century, rapid subsidence, both natural and human-induced, left these newly-populated areas several feet below sea level.[7][8]

New Orleans was vulnerable to flooding even before the age of negative elevation. In the late 20th century, however, scientists and New Orleans residents gradually became aware of the city's increased vulnerability. Hurricane Betsy in 1965 had killed dozens of residents even though the majority of the city remained dry. The rain-induced 1995 flood demonstrated the weakness of the pumping system.

New Orleans is one of the most visited cities in the United States, and tourism is a major staple in the area's economy. Approximately 14 million people visit New Orleans each year. The city's colorful Carnival celebrations (leading up to mardi gras or "Fat Tuesday", the feast day before "Ash Wednesday") during the pre-Lenten season, centered (for tourists at least) on the French Quarter, draw particularly large crowds. Other major tourist events and attractions in the city include the Sugar Bowl, the New Orleans Jazz & Heritage Festival (popularly known by locals as "Jazz Fest"), Voodoo Music Experience, Southern Decadence (one of the largest annual Gay/Lesbian celebrations in the world), and the Essence Festival, not to mention sporting events including Super Bowls and NCAA final fours.

New Orleans is also an industrial and distribution center, and the busiest port system in the world by gross tonnage. The Port of New Orleans is the largest U.S. port for several major commodities including rubber, cement and coffee. The Port of South Louisiana, also based in the New Orleans area, is the world's busiest in terms of bulk tonnage; and when combined with the Port of N.O., forms the 4th largest port system in volume handled.

Like Houston, Texas, New Orleans is located in proximity to the Gulf of Mexico and the many oil rigs lying just offshore. Louisiana ranks 5th in oil production and 8th in reserves. Louisiana is also home to two of the four Strategic Petroleum Reserve (SPR) storage facilities: West Hackberry in Cameron Parish and Bayou Choctaw in Iberville Parish, Louisiana. Other infrastructure includes 17 petroleum refineries with a combined crude oil distillation capacity of nearly 2.8 million barrels per calendar day, the second highest in the nation after Texas. Louisiana has numerous ports including the Louisiana Offshore Oil Port (LOOP), which is capable of receiving ultra large oil tankers. Natural gas and electricity dominate the home heating market with similar market shares totaling about 47 percent each. With all of the product to distribute, Louisiana is home to many major pipelines supplying the nation: Crude Oil - Chevron, BP, Texaco, Shell, Exxon, Scurloch-Permian, Mid-Valley, Calumet, Conoco, Koch, Unocal, Dept. of Energy, Locap. Product - TEPPCO, Colonial, Chevron, Shell, Plantation, Explorer, Texaco, Collins, BP. Liquefied Petroleum Gas - Dixie, TEPPCO, Black Lake, Koch, Chevron, Dynegy, Kinder, Dow, Bridgeline, FMP, Tejas, Texaco, UTP. [7] There are a substantial number of energy companies that have their regional headquarters in the city, including BP, Chevron, ConocoPhillips, and Shell Oil Company. The city is the home and worldwide headquarters of two Fortune 500 companies: Entergy Corporation, an energy and infrastructure providing company, and Freeport-McMoRan, a copper and gold exploration company.

The federal government has a significant presence in the area. The NASA Michoud Assembly Facility is located in the eastern portion of Orleans Parish. The facility is operated by Lockheed-Martin and is a large manufacturing facility where external fuel tanks for space shuttles are produced. The Michoud Assembly Facility also houses the National Finance Center operated by the USDA.

Old River Control

- The Atchafalaya was a separate river that had formed to drain a portion of the delta.
- Due to natural overflowing of the Mississippi river banks, the westward meandering of the Mississippi River, and an old meander situated in the right position, the Atchafalaya became a distributary of the Mississippi River.
- The Atchafalaya began to steadily deepen as water flowed from the Mississippi River. As the Atchafalaya began to become deeper, it became more efficient and able to draw more flow from the Mississippi River.
- Without the intervention of Congress and the Corps, the Atchafalaya would have taken over as the main course of the Mississippi. The entire river below this location would have silted up and no longer would be navigable.

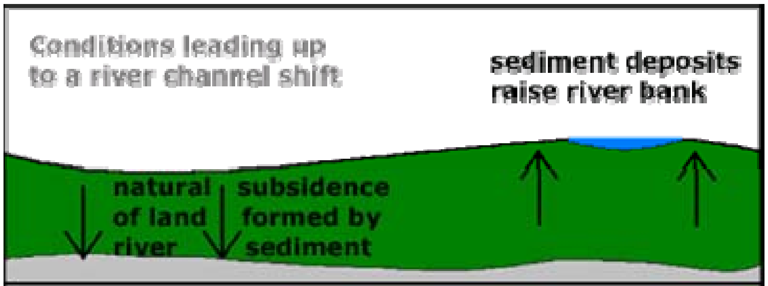
From http://users.stlcc.edu/jangert/oldriver/oldriver.html

The Austin Golding locking thru at Old River.

Old River is the most amazing site along the entire Mississippi. In a word, the Corps of Engineers are successfully (for now) holding back the Mississippi and preventing it from changing course down the Atchafalaya. Should this change happen, the result would be the destruction of the Atchafalaya ecosystem and the inevitable loss of New Orleans and all the industry along the lower Mississippi. The Mississippi's existing channel would turn into a salt water estuary.

To tell the story of Old River we have to change clocks. Our normal perspective, as we survey our world, is framed by our sense of the passage of time. Time for us passes far more quickly than it does for the Mississippi. The events that shape the Mississippi take place in geologic time. The geologic forces that shape the face of the earth are not well measured in days or even years. A century in geologic time is hardly the blink of an eye. To understand Old River we must begin by winding back the geologic clock through a few dozen millennia.

Look at a map of the state of Louisiana and you can see it is shaped something like a boot.



Over the course of many millennia the bottom half of that boot has been created by the Mississippi. Southern Louisiana is built entirely of river sediment carried by water from as far away as the Rocky Mountains. As the Jefferson River gushes down a Montana mountainside it picks up little bits of that mountain and carts them off to the Missouri River. As the Wabash flows through prime Indiana farm land it picks up some of that land and carries it to the Ohio River. The process is cumulative until finally, the Mississippi, loaded with two million tons per day of washed away mountain and farm field, reaches sea level and slows down enough to unburden its load in southern Louisiana.

To build up all of southern Louisiana, the Mississippi has had to move around. Every couple of millennia it takes a major turn, abandons it's old channel, and finds a new one. The last time this happened was at the site where Donaldsonville now sits. Bayou Lafourche used to be the Mississippi. The next time this will happen will be at Old River.

It's during floods that the river deposits sediment to build up the surrounding land. Sediment, carried by the river current, settles out as the water slows down. When sediment laden floodwater breaches the river bank it slows down and the heaviest sediment is deposited nearest the bank. Likewise when the river reaches sea level it slows and sediment is deposited in the channel. Together these actions work over the course of centuries to raise the river up above the surrounding countryside. Southern Louisiana, as we noted, is composed entirely of river silt which slowly subsides under its own weight. The land farthest away from the river doesn't receive enough flood sediment to offset this subsidence and it sinks. Over the course of geologic time the river rises up on its own sediment as the surrounding land sinks under its own weight. This process eventually produces a difference in elevation between the two that gravity will not tolerate. One day (in human time), during high water, the river finds a weakness in it's natural levee and within hours a new river channel emerges.


Low Sill structure, discharge side, low water

When Pierre d'Iberville sailed into the mouth of the Mississippi in 1699 he wasn't thinking in geologic time. Neither was his brother Jean de Bienville when he founded New Orleans in 1718. By then the Mississippi was already leaking into the Atchafalaya. At the location we now call Old River, about 314 miles from the river's mouth, there was a loop in the river not unlike the New Madrid loop today. Three rivers met in that loop. The Red River from Texas flowed into the Mississippi while the Atchafalaya River flowed out. When New Orleans was a bustling and prosperous city just a few years beyond one hundred, Henry Shreve was a Mississippi river hero. In 1831 steamboats by the hundreds plied the river's treacherous waters. Captain Shreve had already distinguished himself by inventing the snag boat. Snag boats travelled up and down the Mississippi removing sawyers from the river. (A sawyer was a submerged tree that could snag and even sink a steamboat). Henry Shreve also wasn't thinking in geologic time when he decided to dredge across the neck of that river loop at mile 314. He cut off the loop and shortened the river channel and at the same time created Old River.

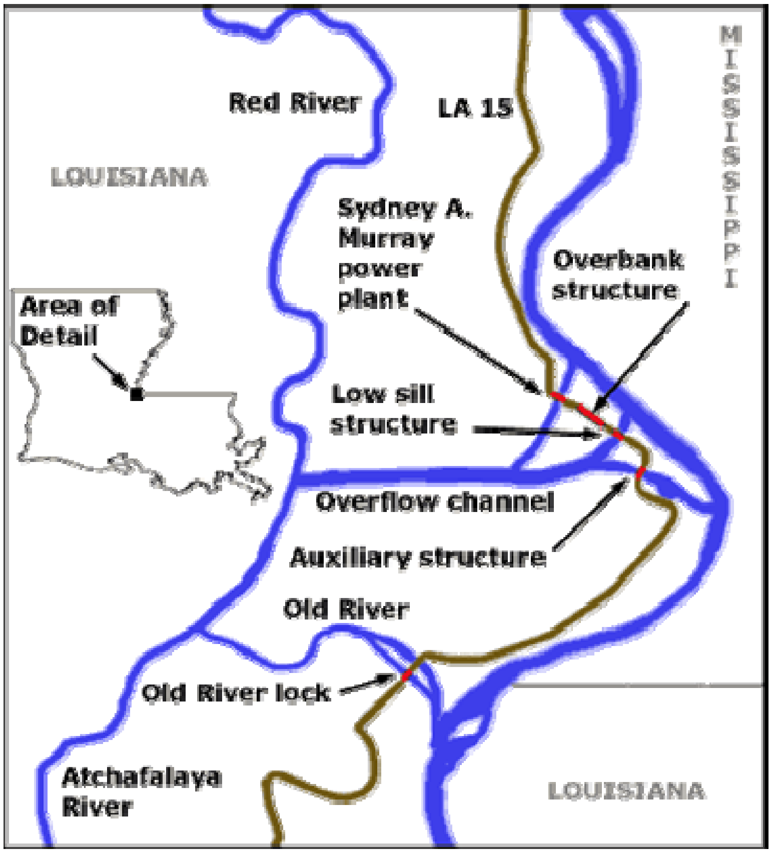

Auxiliary structure, intake side, low water

When Henry was finished, the Red River flowed into the Atchafalaya and Old River, which used to be the bottom half of the loop, flowed out of the Mississippi and into the Atchafalaya. What Henry did was make it that much easier for the Mississippi to take the route of the Atchafalaya, and it would have too, except that the head of the Atchafalaya was blocked by the biggest stubbornest logjam anyone had ever seen.


Overbank structure, discharge side, low water

Well there it was, the situation was staring them right in the face, but the folks back then were thinking in human time. They wanted to navigate the Atchafalaya and so in 1863 the State of Louisiana took out the logjam. In the blink of a geologic eye (about one hundred years) the Atchafalaya widened and increased its draw on the Mississippi so that fully thirty percent of the Mississippi was pouring down the Atchafalaya. There is a fifteen foot difference now between the elevation of the two rivers and the Atchafalaya's route to the Gulf is approx. 140 miles shorter than the Mississippi's -- water always finds the shortest route downhill.

By 1950 what was geologically inevitable became humanly apparent. The Mississippi River Commission delivered a report to Congress in 1953 that detailed the imminent capture of the



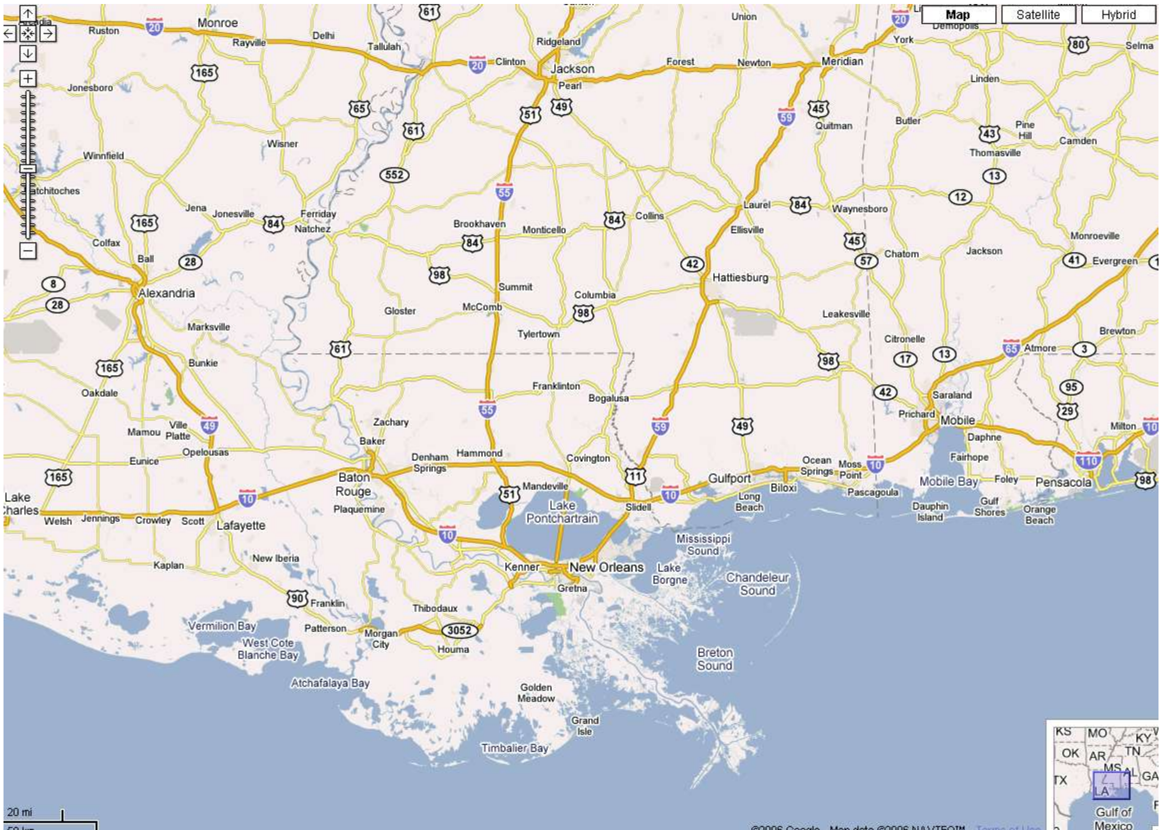
Mississippi by the Atchafalaya. The result would be a human catastrophe and so Congress acted. They appropriated the funds and gave the U.S. Army Corps of Engineers the phenomenal job of stopping the geologic clock. Not only did Congress require that the Corps prevent the Mississippi from changing course at Old River, they also required that the Corps maintain the status quo. They couldn't simply block the Atchafalaya. The fresh Mississippi water that flowed into the Atchafalaya was necessary for the health of the Atchafalaya swamp. Morgan City at the mouth of the Atchafalaya needed that water as did the rural economy in the Atchafalaya basin. The Corps' job was to hold the Mississippi and yet maintain a constant flow of Mississippi water into the Atchafalaya. In effect they had to build a valve into the Mississippi that they could open and close as required. Easier said than done.

It's been nearly forty years since the Low Sill and Overbank structures went into operation in 1963. But what is forty years in geologic time--not even the blink of an eye. Since then there have been a number of skirmishes in the battle engaged. In 1973 the Corps almost lost. The 1973 flood nearly destroyed the Low Sill structure. It's been repaired but it's no longer up to its original design specifications. The river claimed the southern wing wall of the structure, and nearly undermined its foundation which is sunk ninety feet into the river bottom. Originally designed to withstand a difference of thirty seven feet in water levels between a raging Mississippi and a hungry Atchafalaya, the Low Sill structure has been repaired to withstand a head difference now of twenty two feet. To bolster its efforts the Corps have constructed the Auxiliary structure which went on line in 1986. Between the two they are now better prepared than before, to hold the Mississippi in place.

The map above shows conditions as they exist today. A lock on Old River makes it possible to travel between the two rivers. The overflow channel was dug when the original Low Sill structure was built in 1958. The Low Sill and Auxiliary structures work together to control the amount of water released into the Atchafalaya. The Overbank structure is a spillway that remains closed during normal and low water stages. It's gates are opened during high water to relieve stress on the Low Sill structure. The most recent addition to the complex is the Sydney A. Murray hydroelectric plant. Louisiana's first hydroelectric generator, it takes advantage of the fifteen foot head between the two rivers to generate power.

Can they do it? Can the Corps keep the hands of the geologic clock from striking the final hour. The experts are all betting against them, but the experts are all focused on the geologic clock. What possible chance have we to deny nature. Are we going to cork a volcano, suture an earthquake fault, direct a hurricane or tell the Mississippi to please take the next right. Ask a Corps engineer and you're liable to get a wry smile and a, "who knows?" They're focused on the human clock. "We held it today and we'll hold it tomorrow." It's been thirty seven years they've held it now--thirty seven very human years--nearly half a lifetime. That's an achievement by any human measure and during that time we've benefitted from their efforts. Tomorrow I expect they will hold the Mississippi at Old River yet another day. Let the geologic clock tick if it must; I measure time by a different standard.

If you'd like to learn more about the complex at Old River, you must read *The Control of Nature* by John McPhee. McPhee is a wonderful writer and *The Control of Nature* is one of the best books you'll ever read. It's so good that I suggest you turn off your computer right now and head straight for the library. This is one of those books you can't put down until you've read it straight through.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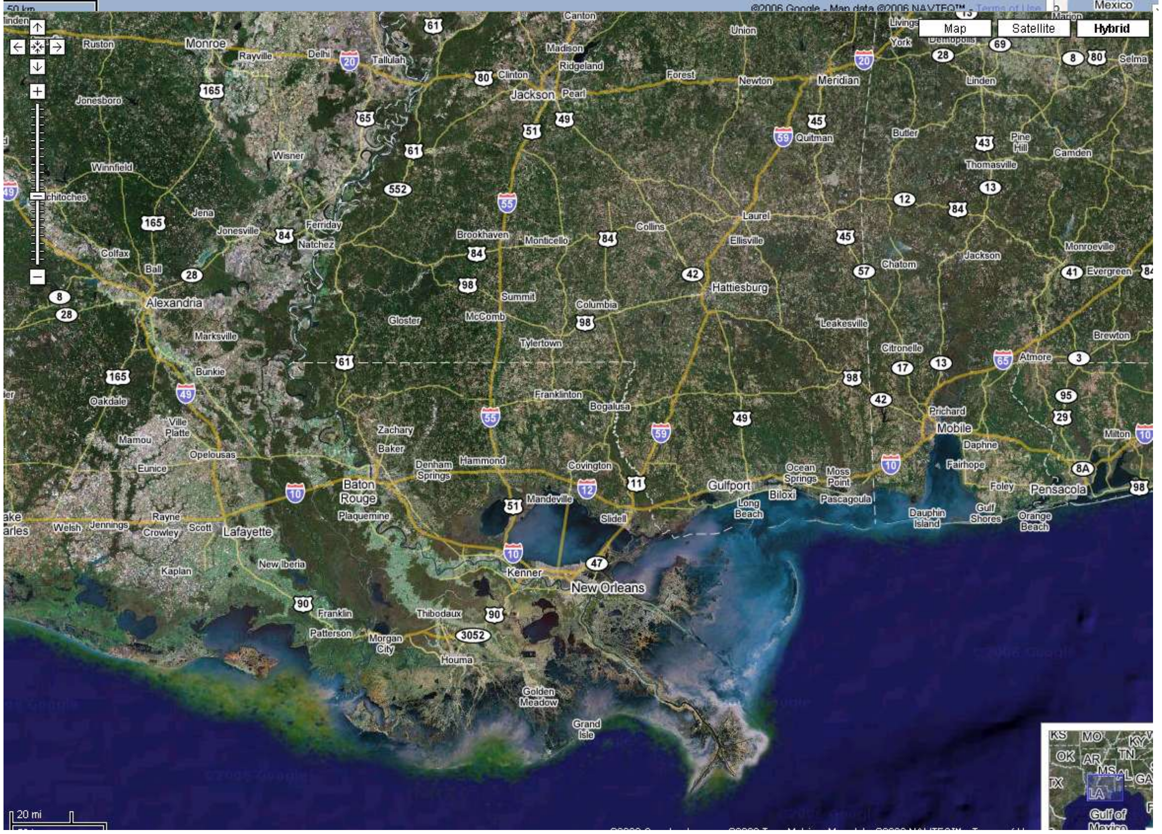
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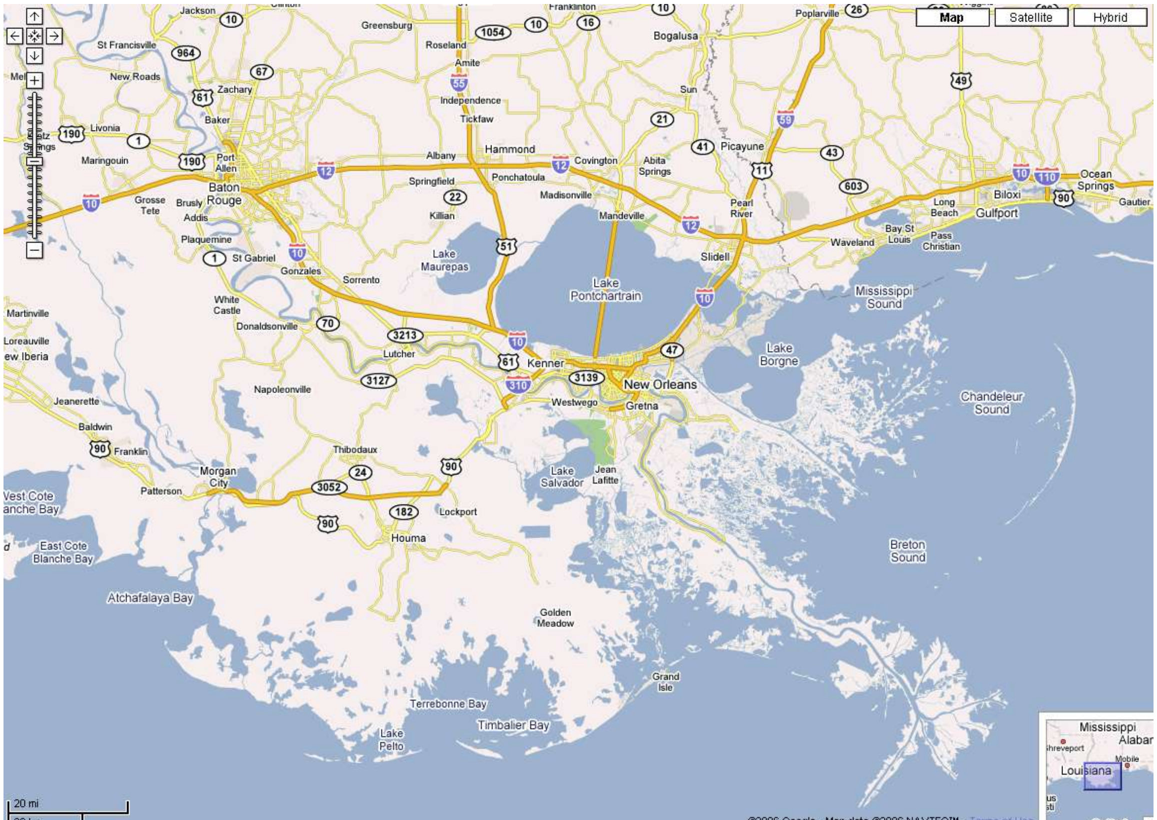
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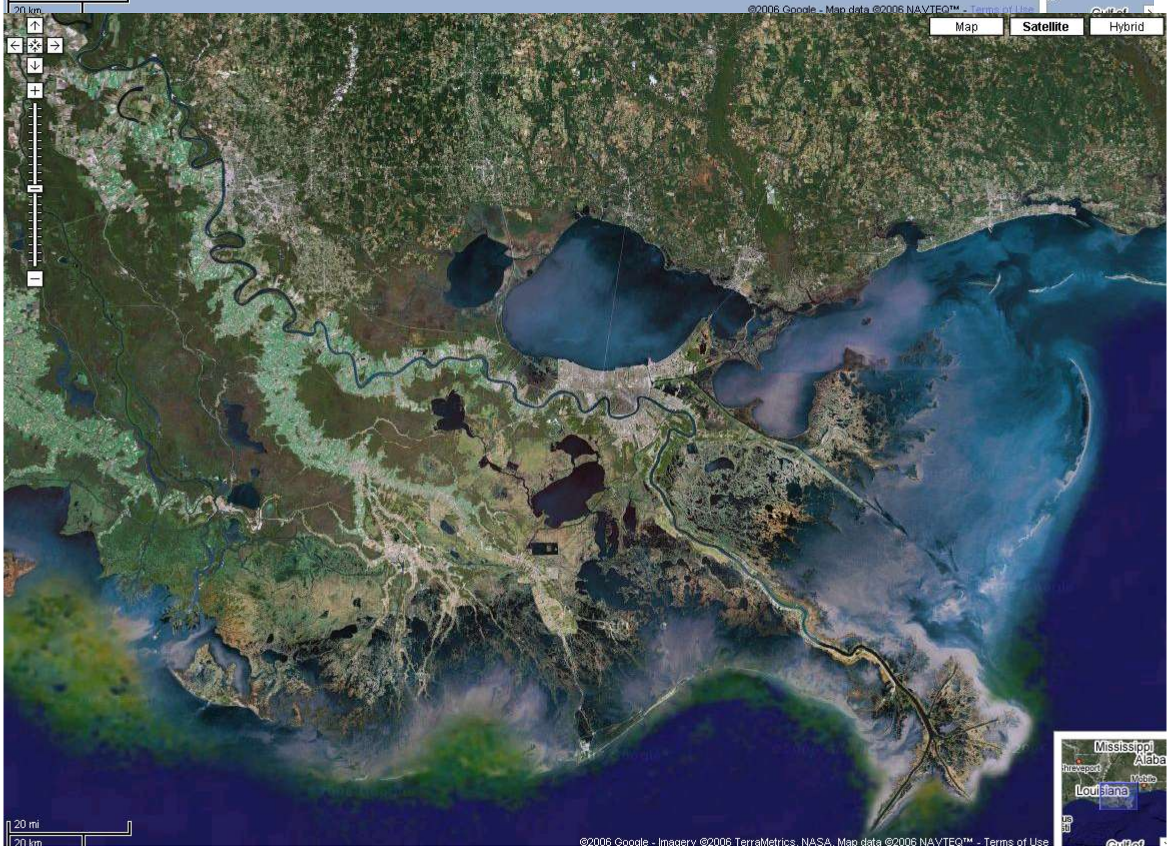
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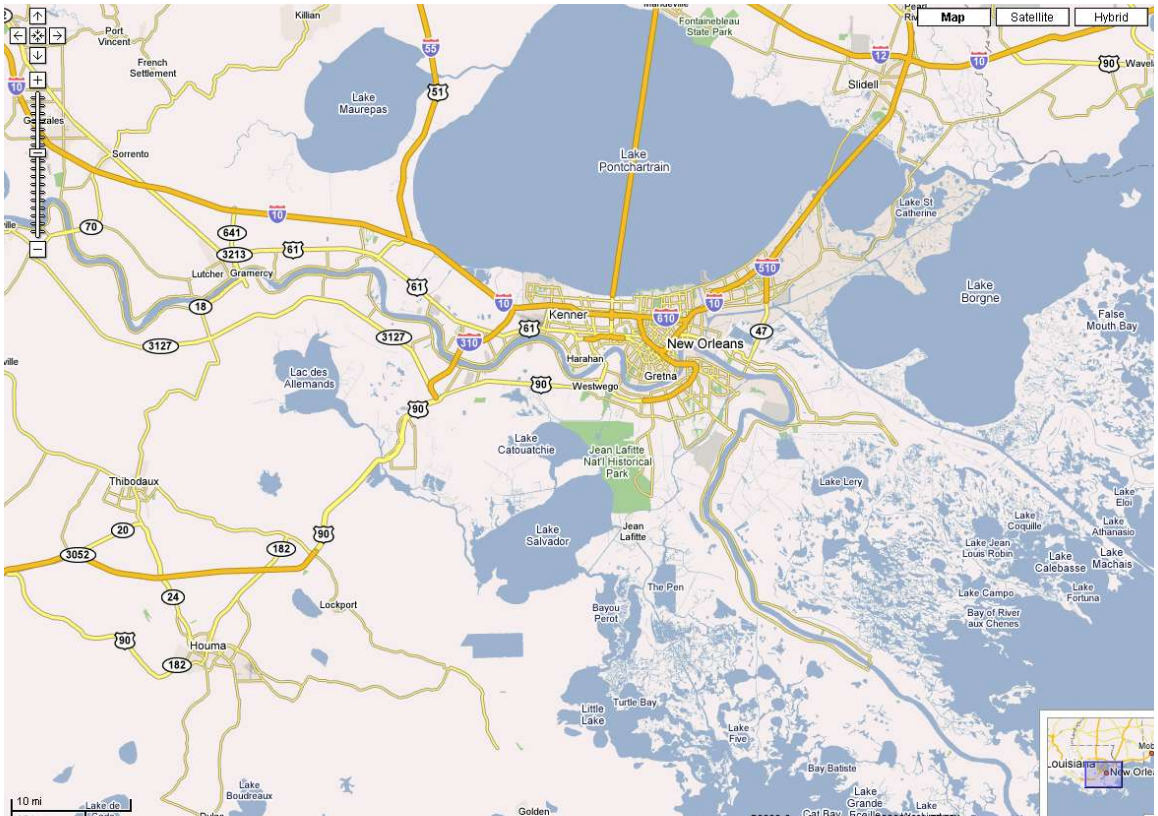
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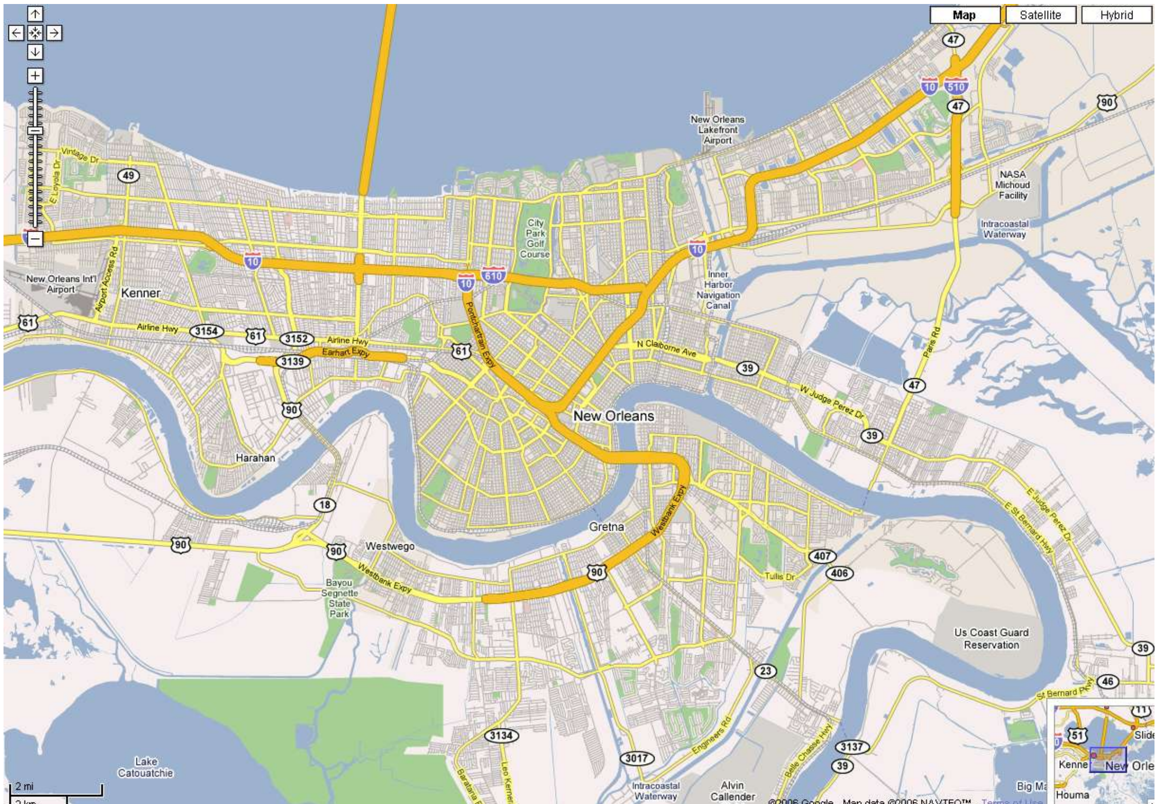

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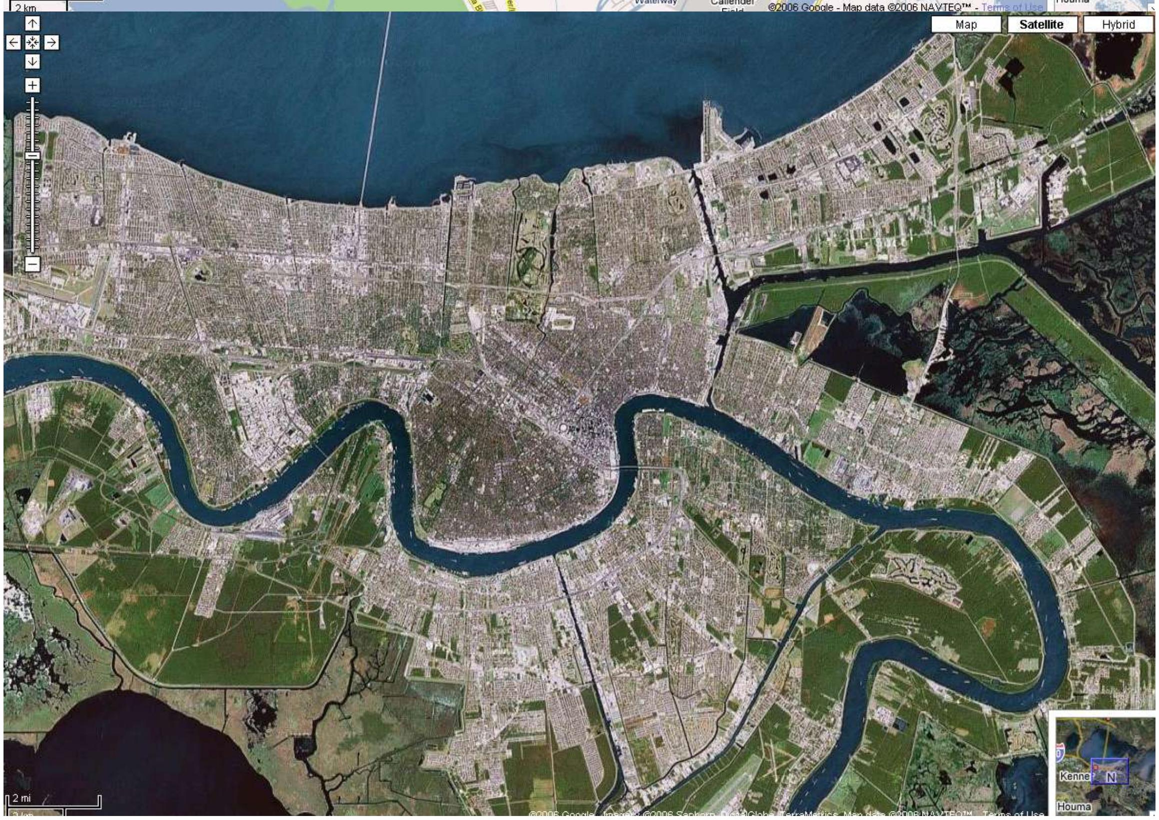

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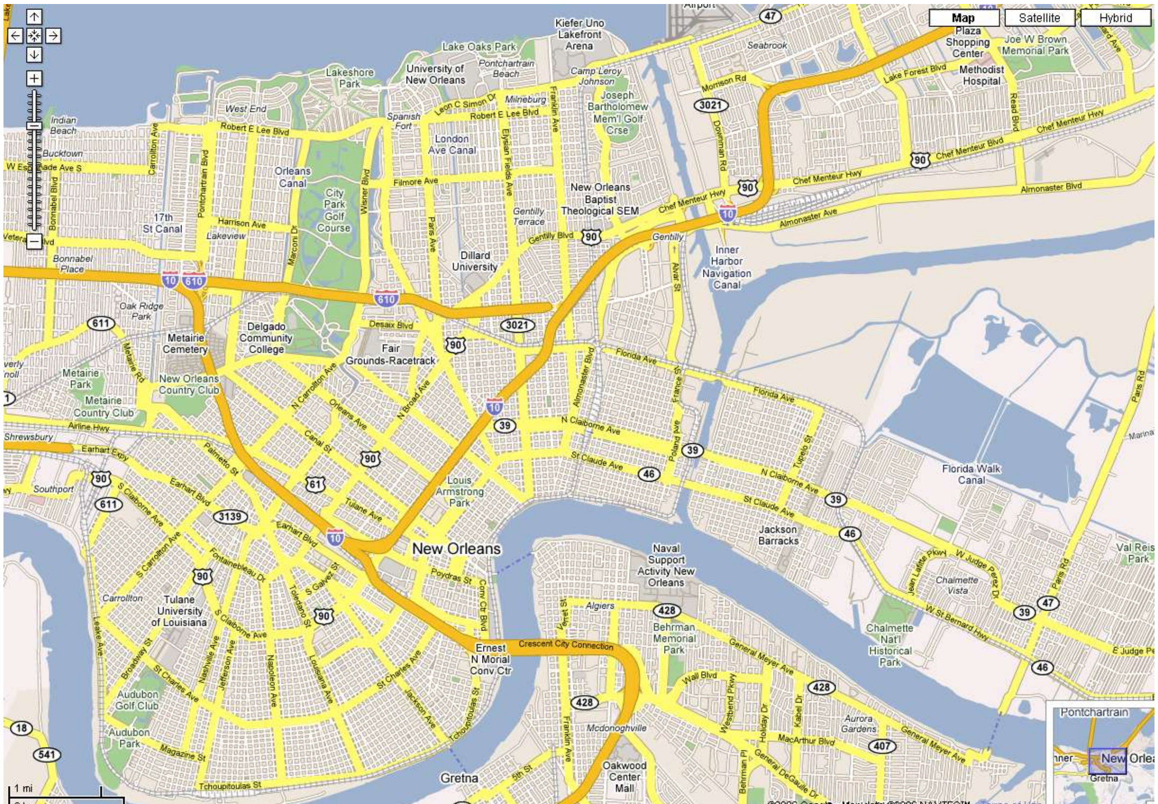
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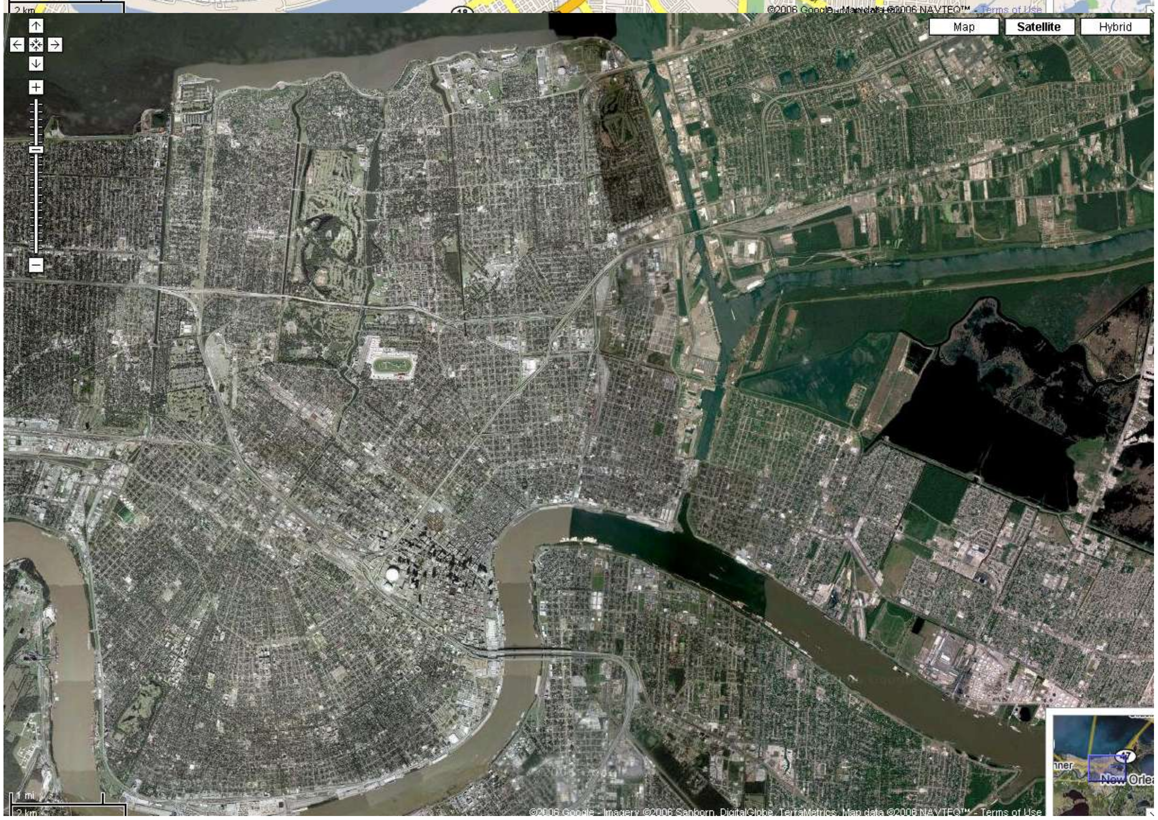
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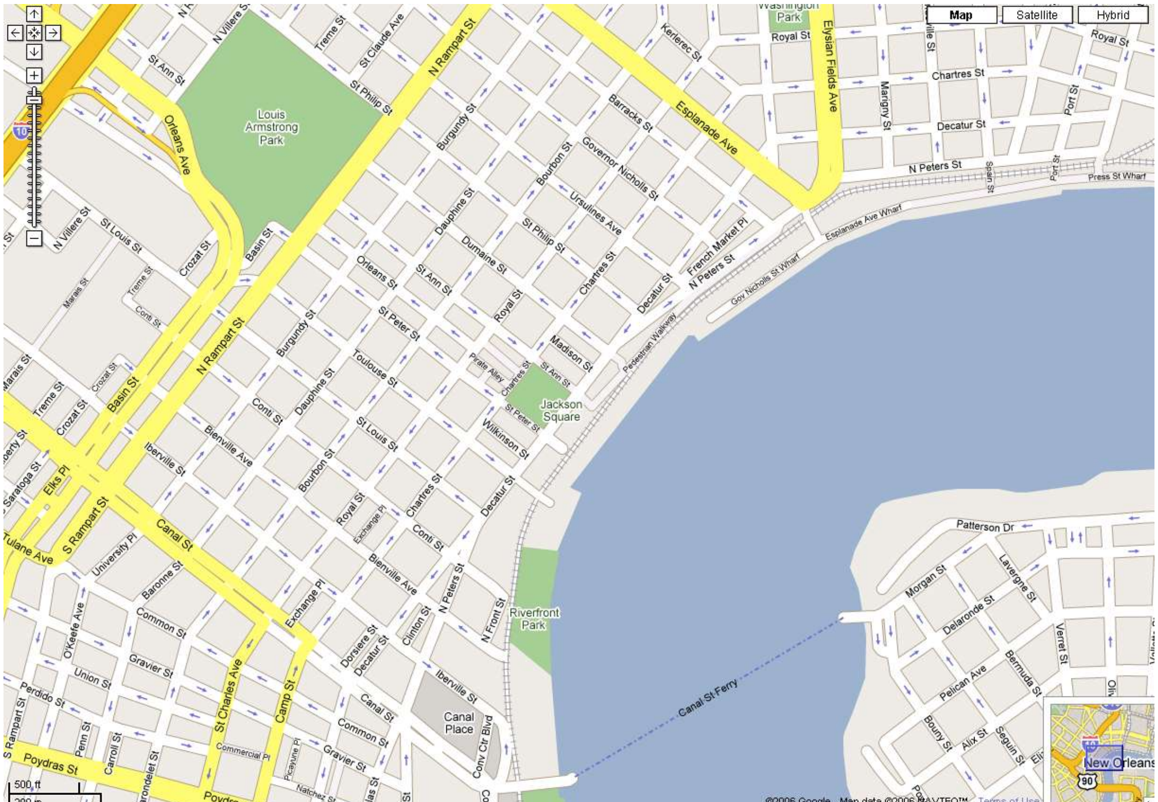
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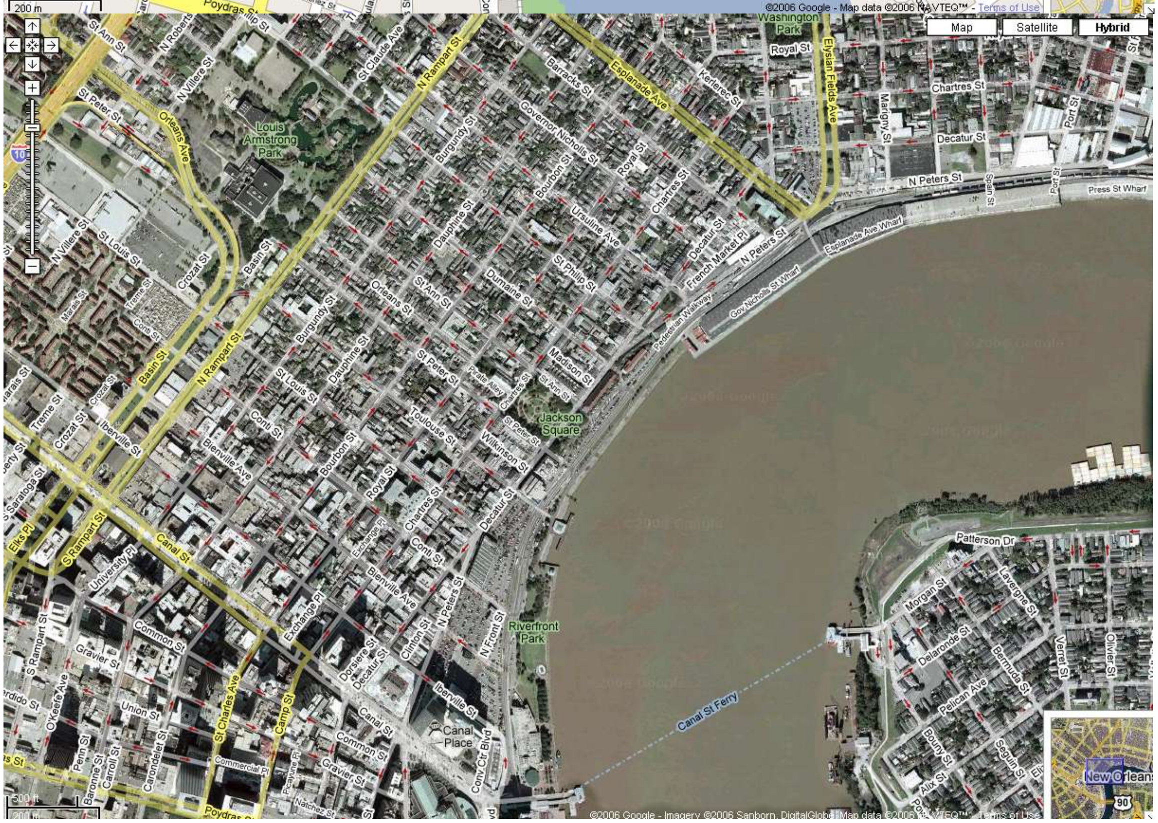
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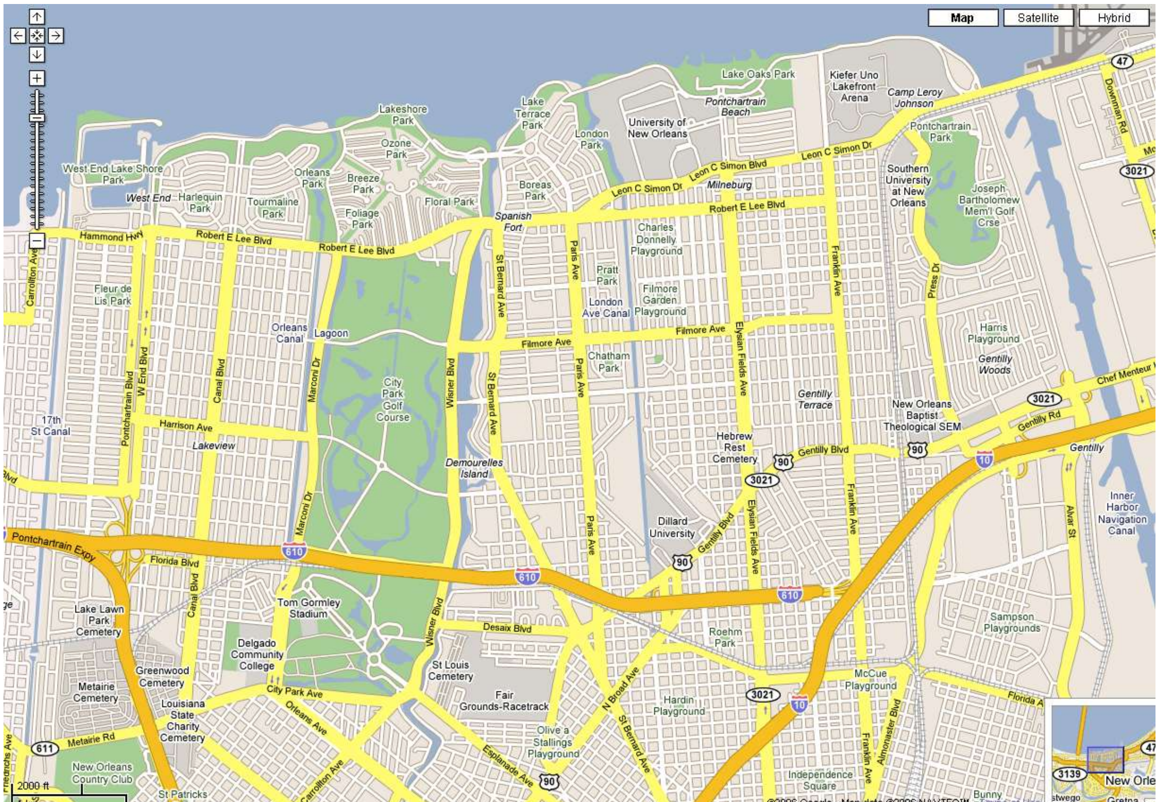
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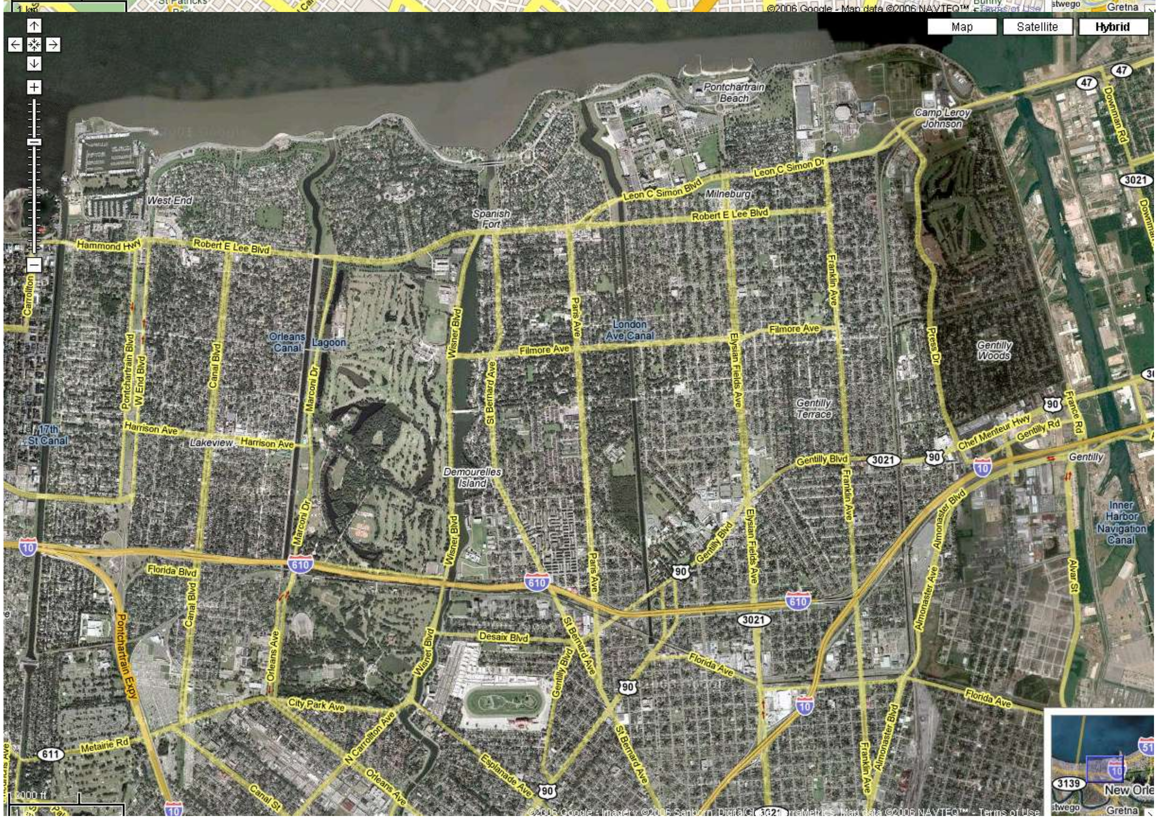
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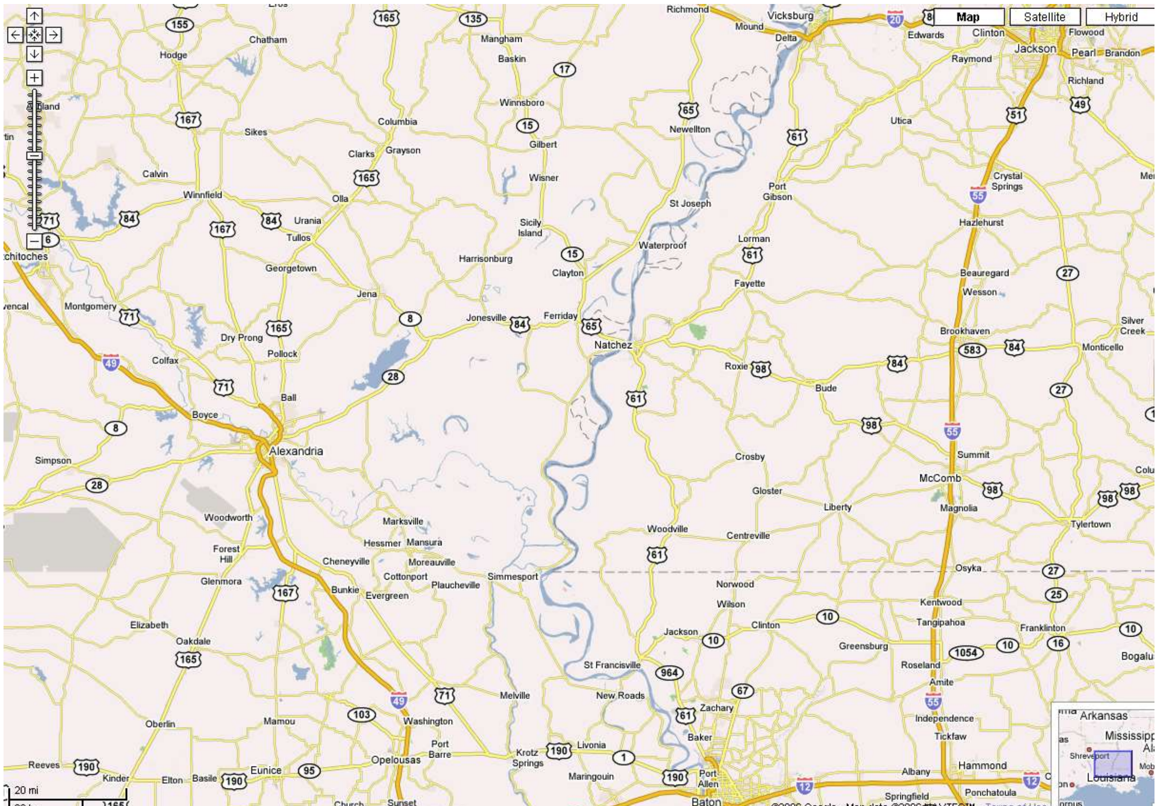
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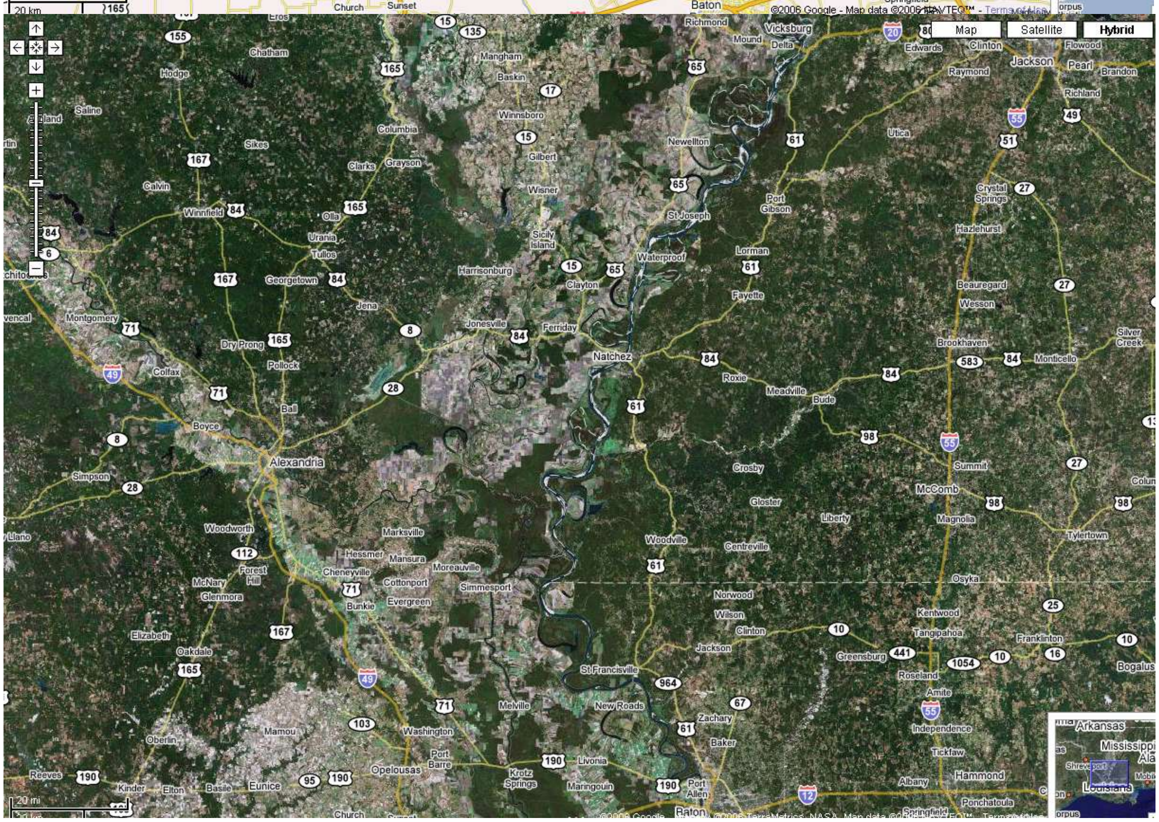
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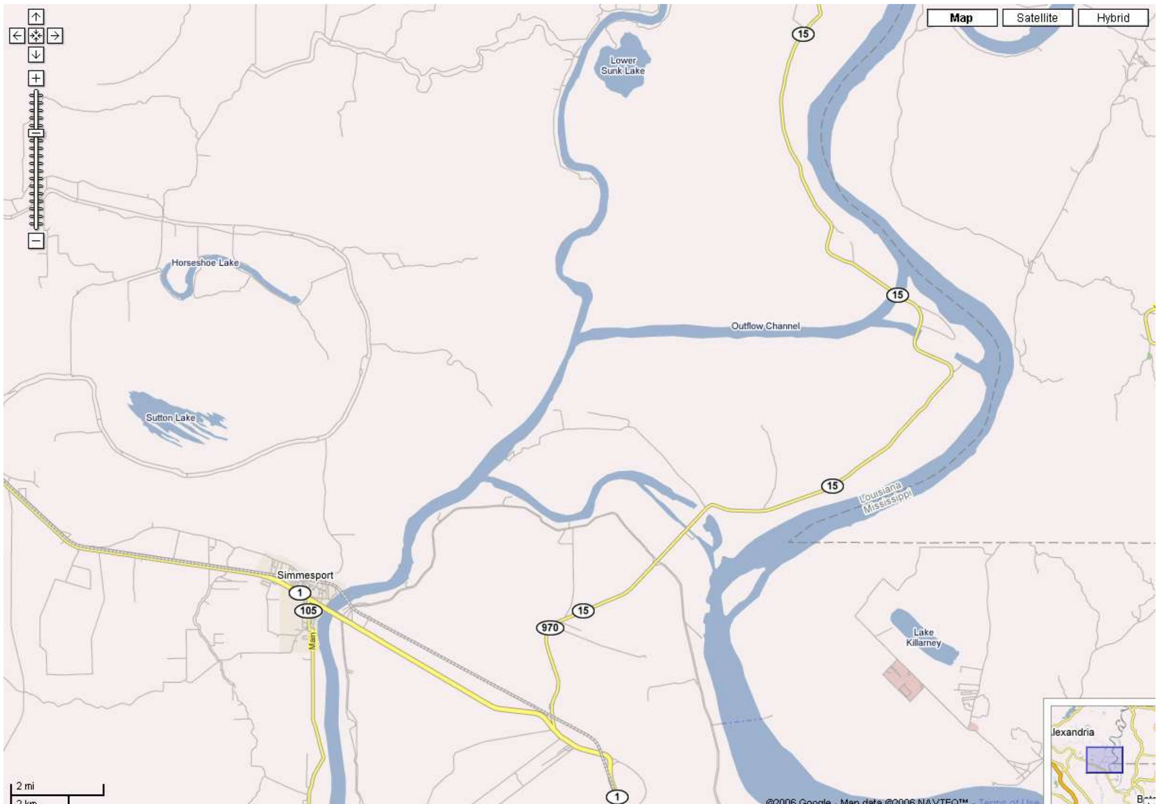
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Map
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