Lecture 1

Why Do We Have Levees in Louisiana?

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for the

First Annual Levee School Symposium

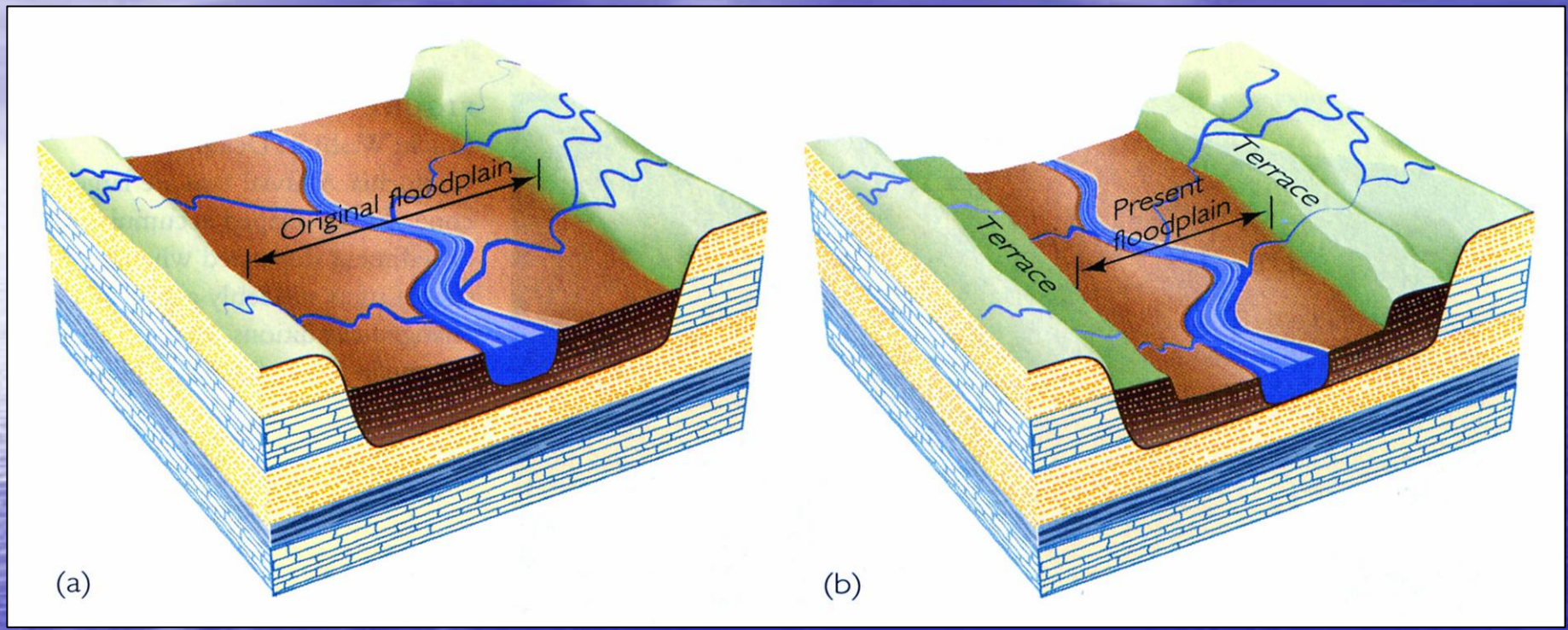
Louisiana State University

Baton Rouge, Louisiana

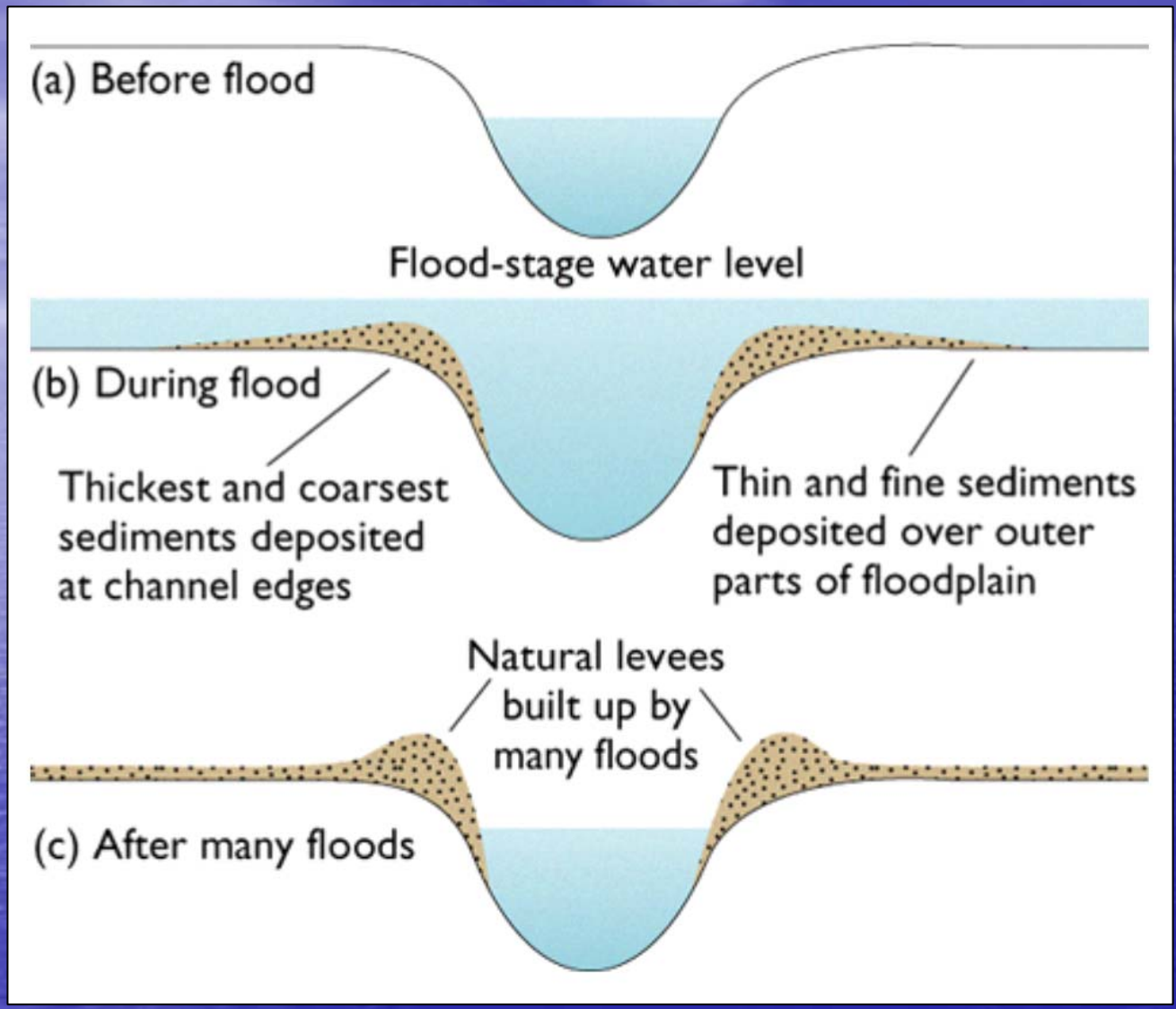
November 28, 2007

- **Army Engineer A.A. Humphreys** began studying the river in 1850, and virtually controlled it as Chief of Engineers between 1866-1879. He was the father of the Corps' flawed "levees only" policy of flood control.

FLOOD PLAINS

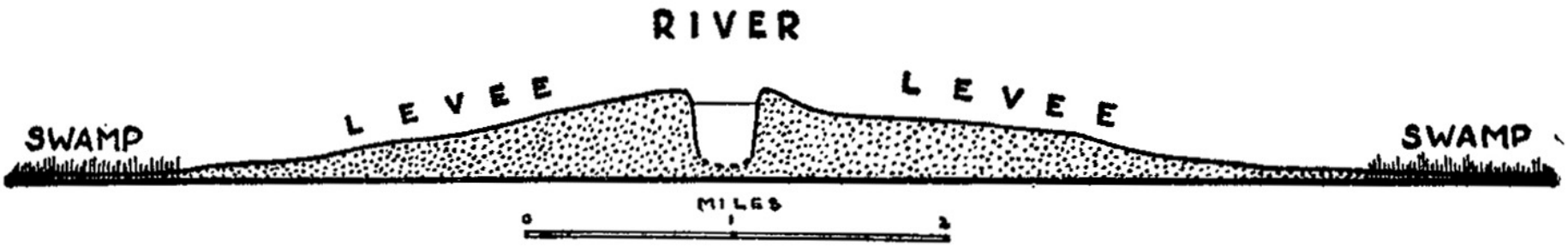


- **Flood plains are those alluvial valleys that are periodically subject to inundation by flooding of a natural river. 75% of the sediment deposited on our continent is flood plain silt.**



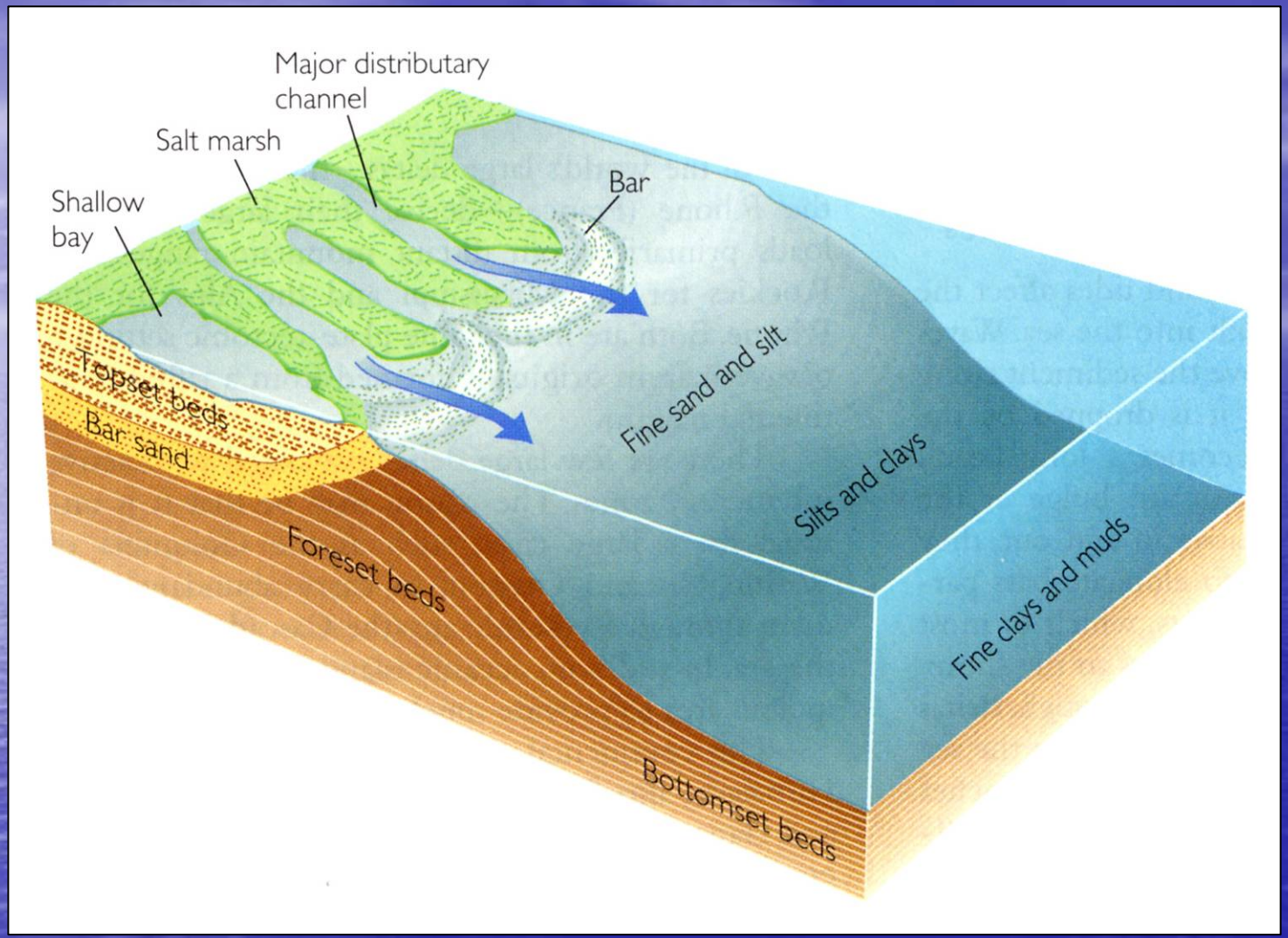
- **Levees** are a natural features that form along low gradient streams subject to overbank flooding

The river is the high ground in the Mississippi Embayment

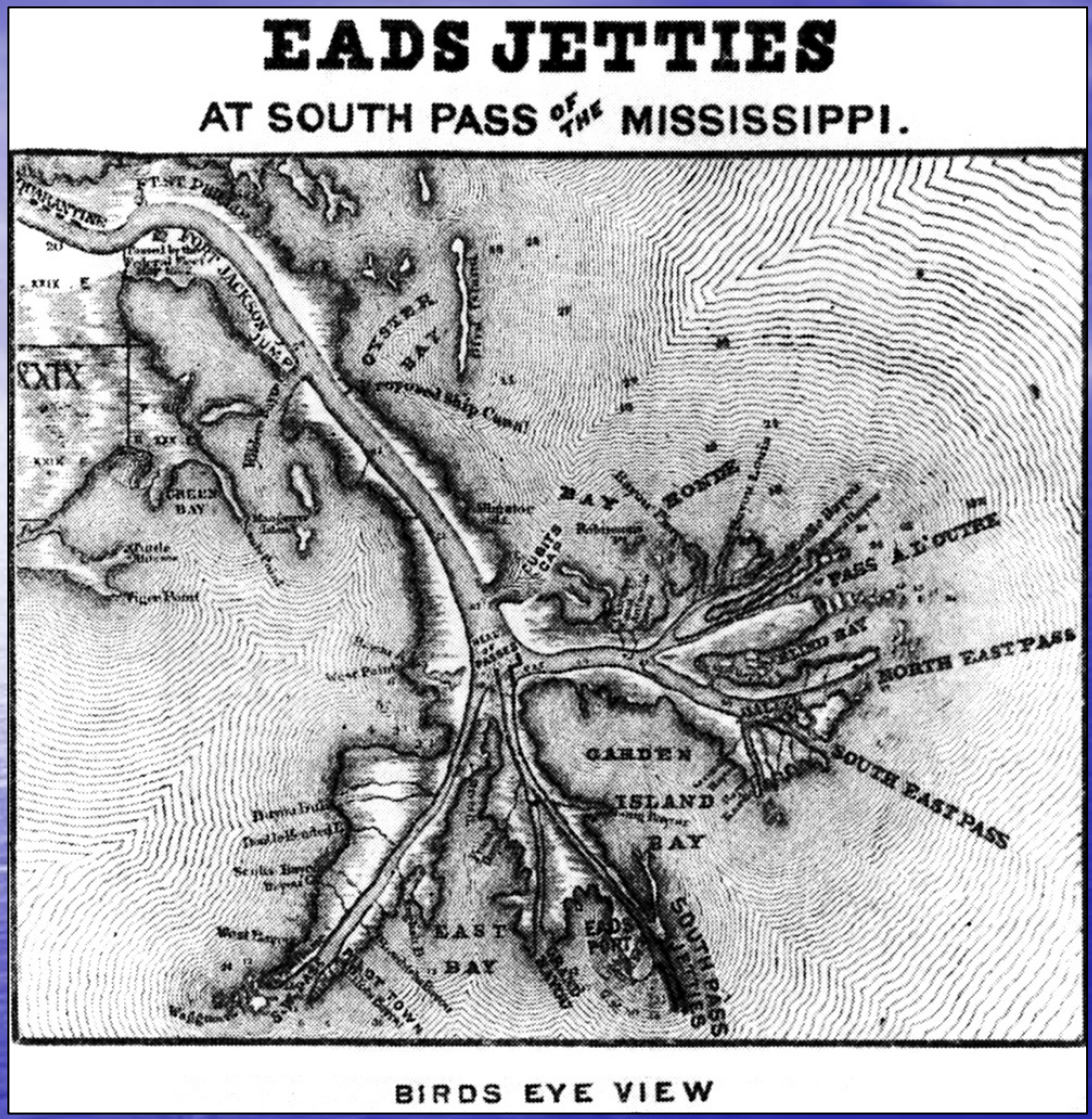


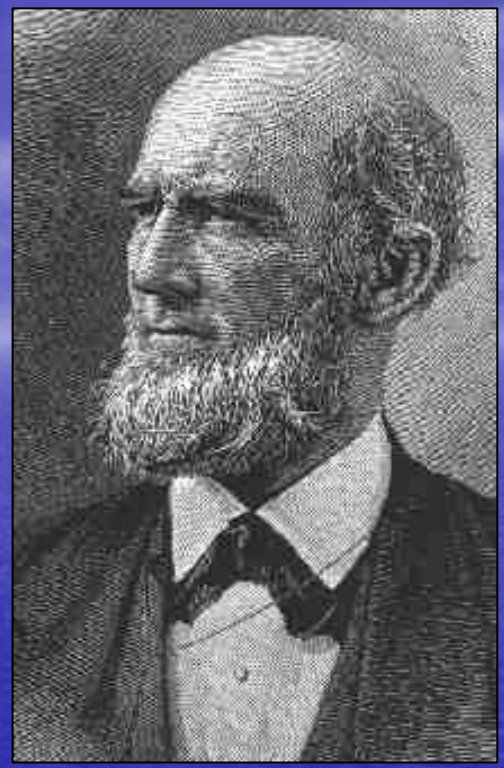
PROFILE OF THE MISSISSIPPI RIVER AT BELLE POINT

- A vexing problem with a high silt load river is that it tends to build up its own bed, which prevents drainage of the adjoining flood plains. Millions of acres of swamp land was reclaimed by drainage along the Mississippi River, beginning around 1910.



- **Sand Bars closed off the mouth of the Mississippi River each year for as much as 3 months at a time following high flows.**

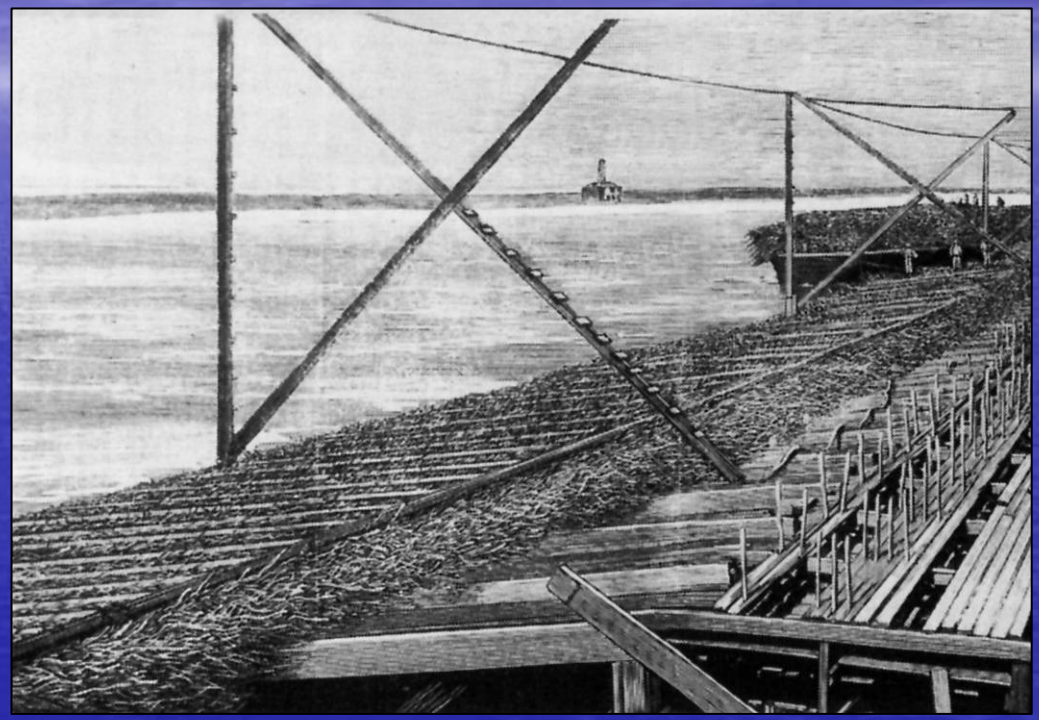




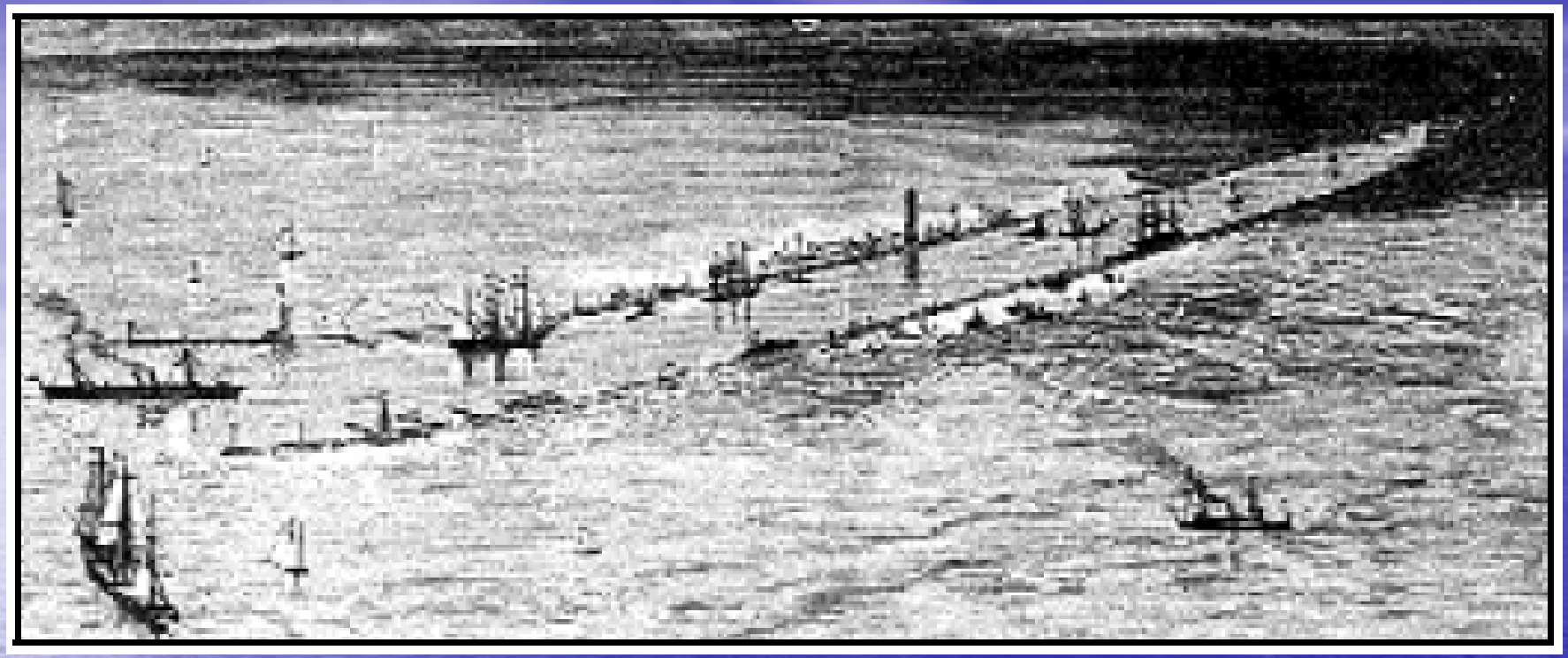
James Buchanan Eads – inventor of the Mississippi jetties

- **The Corps of Engineers searched for a engineering solution that would provide a 30 foot deep navigational channel at the mouth of the Mississippi Delta.**

Eads and Andrews constructed their novel jetties between 1875-79

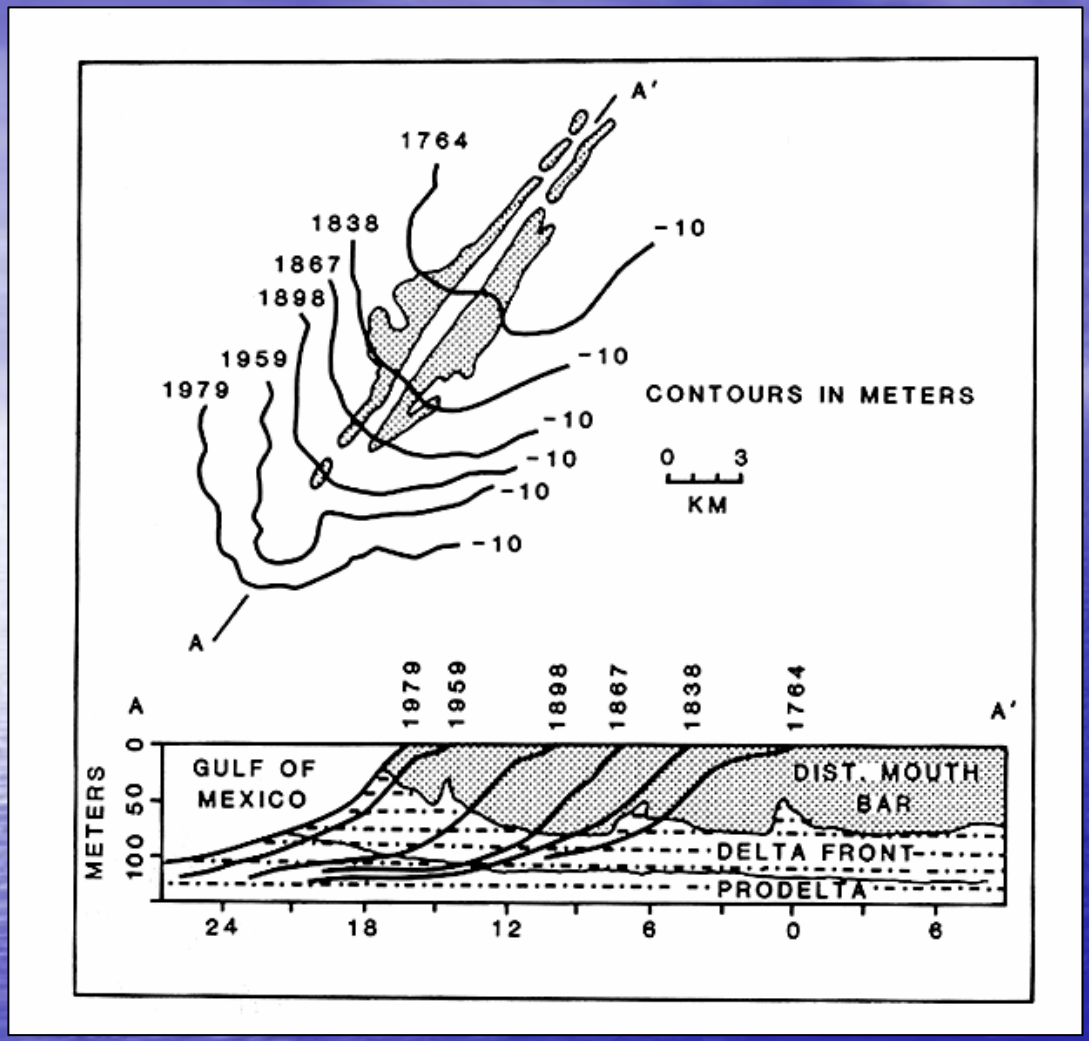


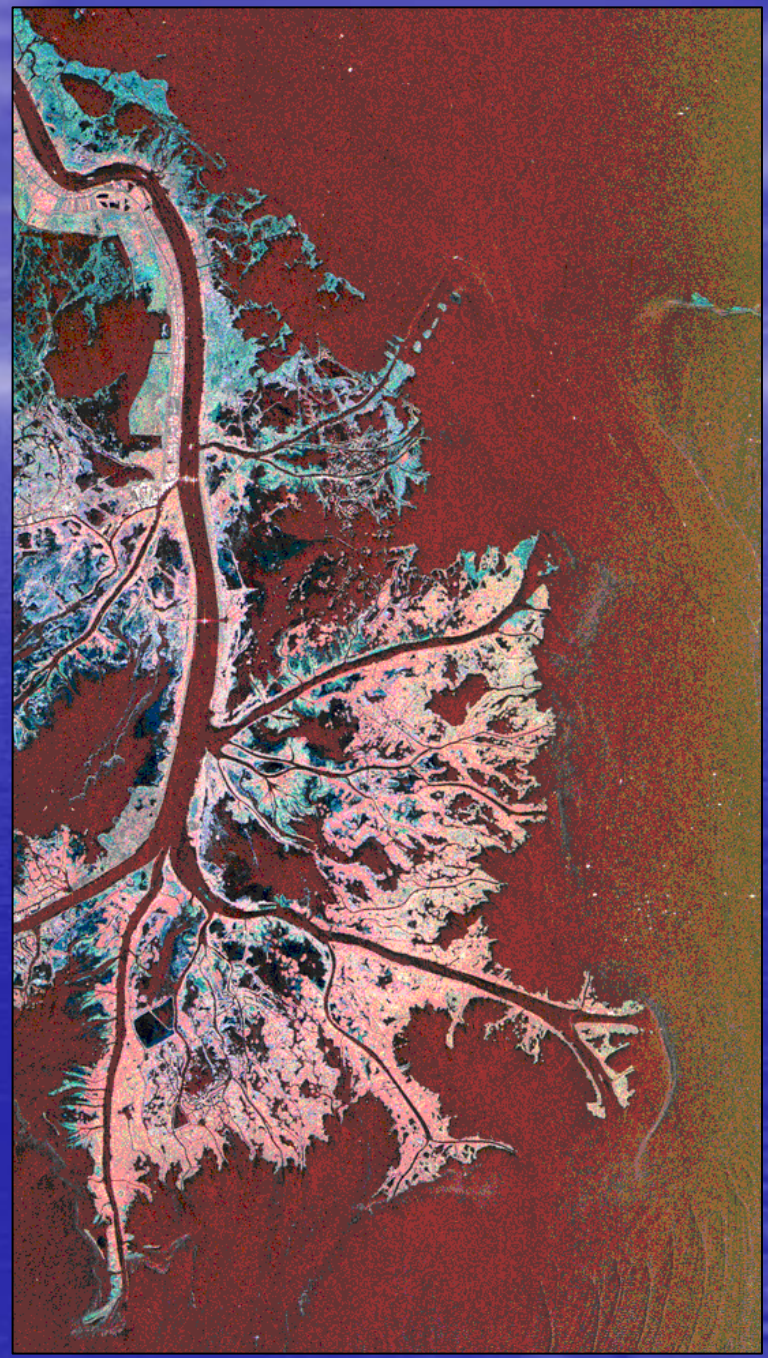
Eads and James Andrews employed woven willow mattresses using a novel patented method, laid over wooden piers 2.33 miles long, and faced with quarried rock to form the jetties. They were designed to constrain river flow past the sand bars, to the continental slope. Eads and his investors were to be paid in increments, 20 ft channel October 1876; 24 ft by March 1877, and so on; reaching 30 feet by mid 1879.



General Humphreys and the Army Corps of Engineers did everything they could to stymie Eads and his jetties. The project was on the verge of bankruptcy, when on May 12, 1876, the 280 ft long steamer *Hudson* became the first deep draft ship to pass through South Pass jetties, sailing upriver to New Orleans. The jetties succeeded beyond anyone's expectations, reaching a depth of 30 feet by June 1879.

- In 1875 7,000 tons of goods were shipped between St Louis and Europe, via the Mississippi River through New Orleans.
- By 1880, this figure had jumped to 450,000 tons per annum, 65X the pre-jetty level.
- New Orleans went from being the 9th largest to 2nd largest port in the United States; second only to New York.





- **The mouth of the Mississippi River has extended 16 km since 1764; 11 km since the jetties were emplaced.**

Mississippi River Commission

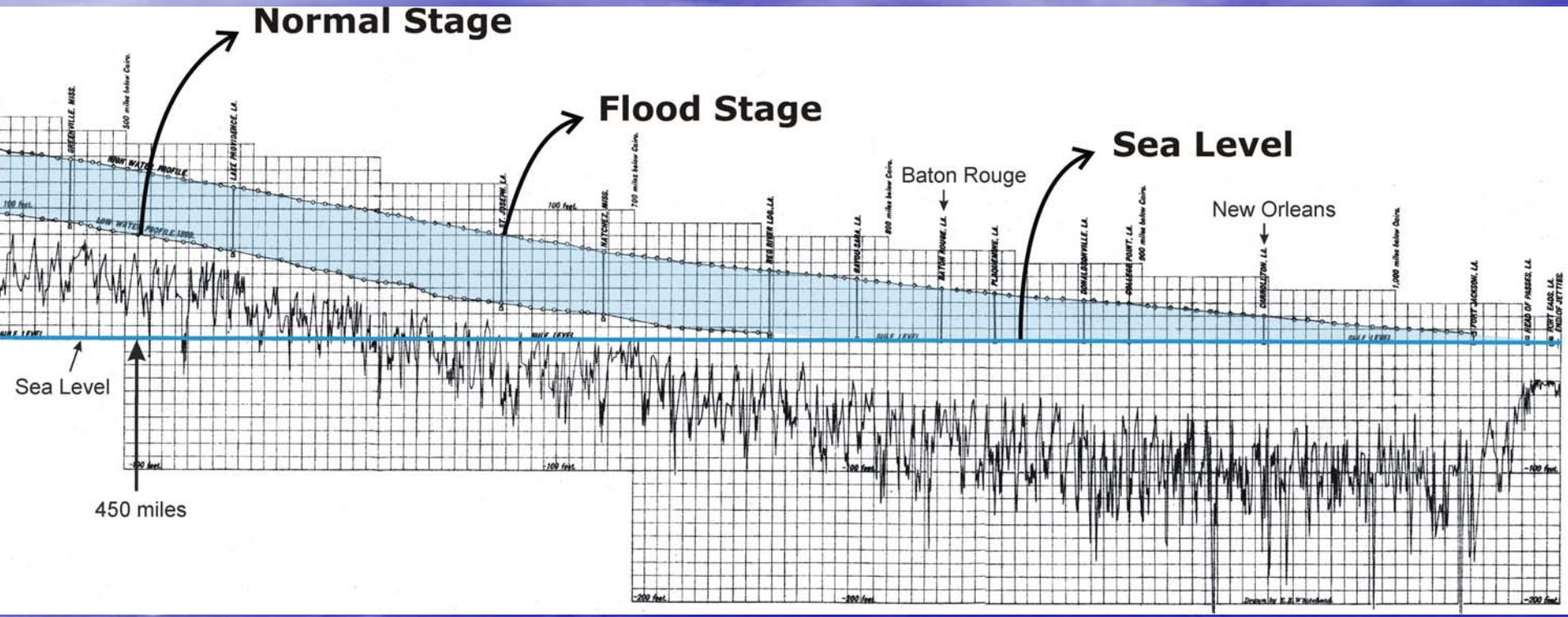
- Idea conceived by James B. Eads, beginning in 1877. Bill passed by Congress in 1879.
- The Mississippi River Commission (MRC) was staffed by Army Engineers 3 to 2 over civilian members.
- Opposed outlets or offstream storage.
- Opposed channel cutoffs at meanders
- Embraced “levees only concept”, hoping main channel would scour deeper

The employment of dual levees, lengthening of the jetties, and silt load of the river have combined to heighten the channel bed and lower the hydraulic grade of the river. This means the river surface is RISING, so levees have to be heightened. This has been an ongoing problem since the late 19th Century.

NAVIGATION CHANNELS – MISSISSIPPI RIVER BELOW BATON ROUGE

- After the mouths of the Mississippi River had been opened and maintained in a navigable state, Congress authorized in 1945 the development of a navigation channel for oceangoing traffic in the lower reaches of the river. The depths and widths of the channel between Baton Rouge and the Gulf of Mexico are:
- Baton Rouge to New Orleans - 40 by 500 feet
- Port of New Orleans - 35 by 1,500 feet, with portion 40 by 500 feet
- New Orleans to Head of Passes - 40 by 1,000 feet
- In Southwest Pass - 40 by 800 feet
- In Southwest Pass Bar Channel - 40 by 600 feet
- In South Pass - 30 by 450 feet
- In South Pass Bar Channel - 30 by 600 feet
- Mississippi River-Gulf Outlet - 36 by 500 feet
- Mississippi River-Gulf Outlet Bar Channel - 38 by 600 feet

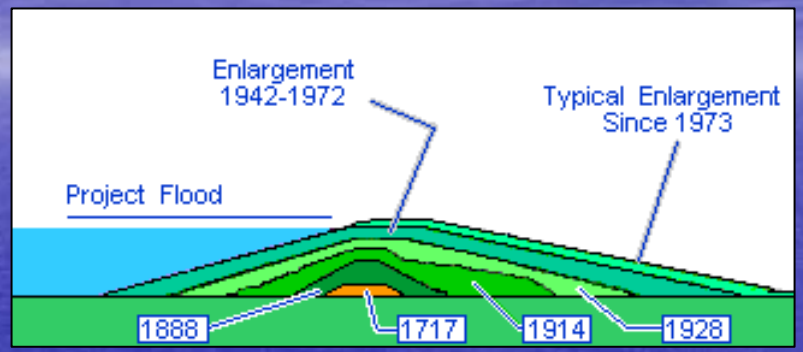
Profile of the Lower Mississippi



The bed of the Mississippi River is below sea level during the last 450 miles of its course, up to Greenville, Mississippi. We can only extract meaningful amounts of sediment during short-lived periods of high flow.

Raising levees

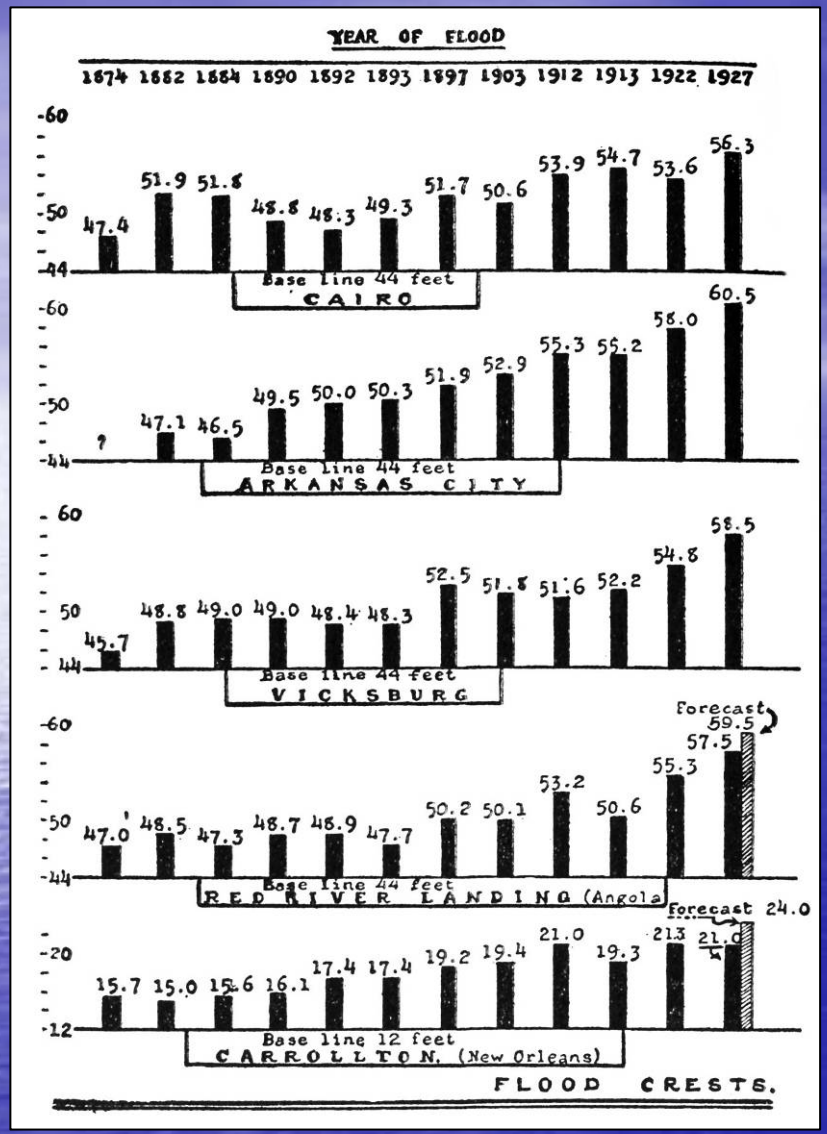
1845 map of New Orleans – note inset wharves



1875 map of New Orleans –wharves gone

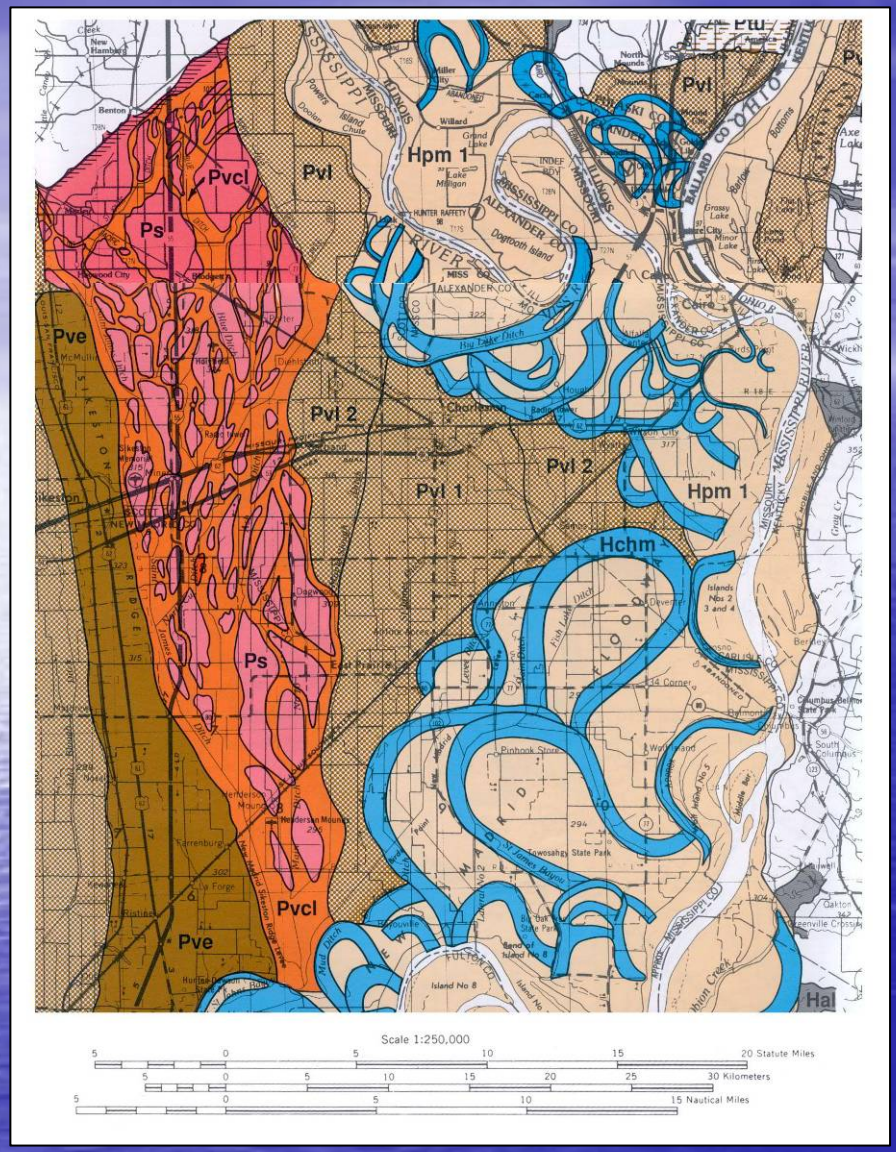
The first levee at New Orleans was constructed in 1717; then heightened significantly in 1888. Protective levee districts were formed in the 1890s.

Rising river bed and raising levees

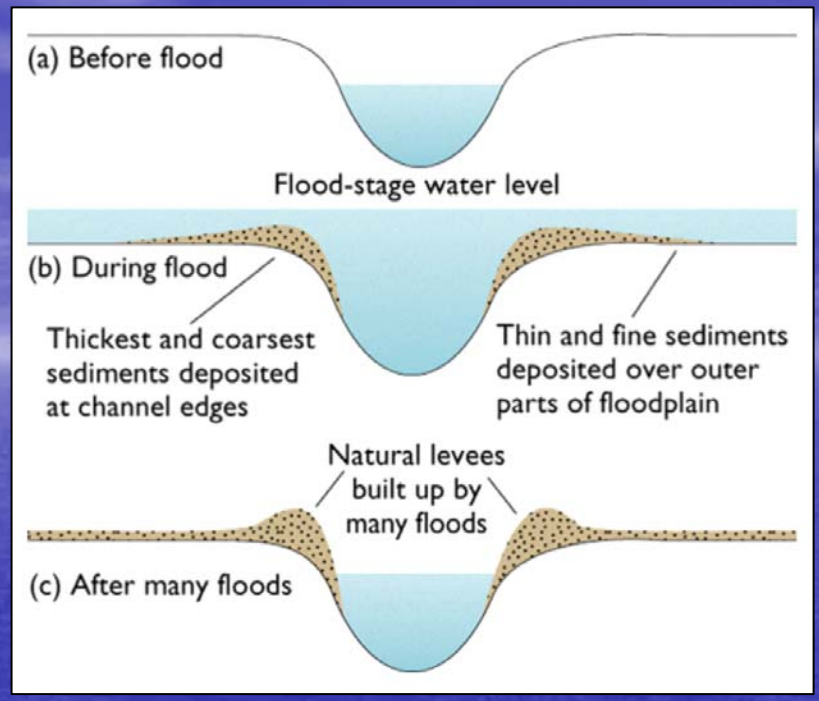


The flood height of the river at New Orleans increased from 15 to 21 feet between 1874 and 1912.

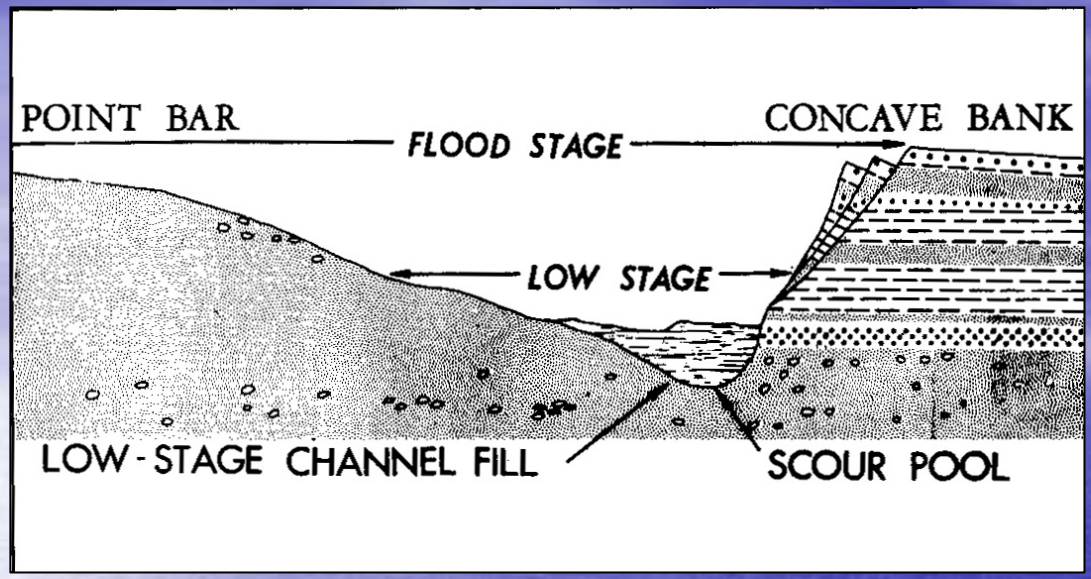
- The levee at Morganza, LA was 7.5 feet high in 1850
- By the mid 1920s, this same levee was 38 feet high, nearly the height of a 4-story building.



Map of Mississippi River Valley showing abandoned meanders. The active channel is shown in white along right side of map.



- **A major shortcoming of the MRC's "levees only policy" was that it was 2-dimensional: ignoring channel curvature and natural channel migration**



Asymmetric channels

- The Mississippi channel is sinuous; migrating towards the outside of downstream bends through bank undercutting. Levees had to set back from these bends.

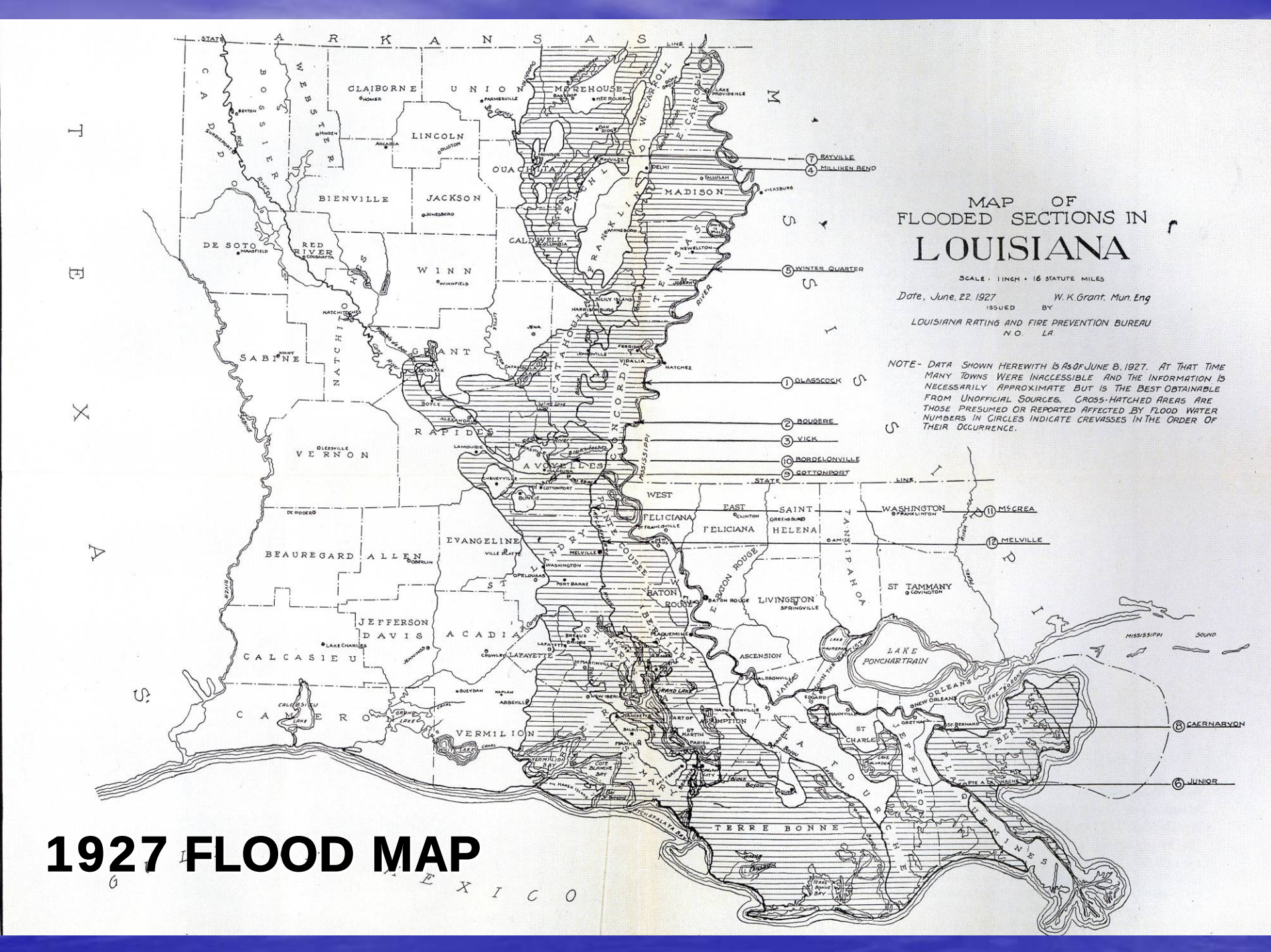
The 1927 Flood

The 1927 flood was the largest ever recorded on the lower Mississippi Valley. 18 inches of rain fell on New Orleans in a 48 hr period in late March 1927, and six months of flooding was to ensue, inundating 27,000 square miles of bottom land; displacing 700,000 people, killing 1,000 more, and damaging or destroying 137,000 structures.

There was an enormous public outcry for the government to do something more substantive about flood control.

DYNAMITE

The political leadership of New Orleans dynamited the Mississippi levee downstream of New Orleans, to save the city from being flooded. It was not necessary, but prompted by fear.

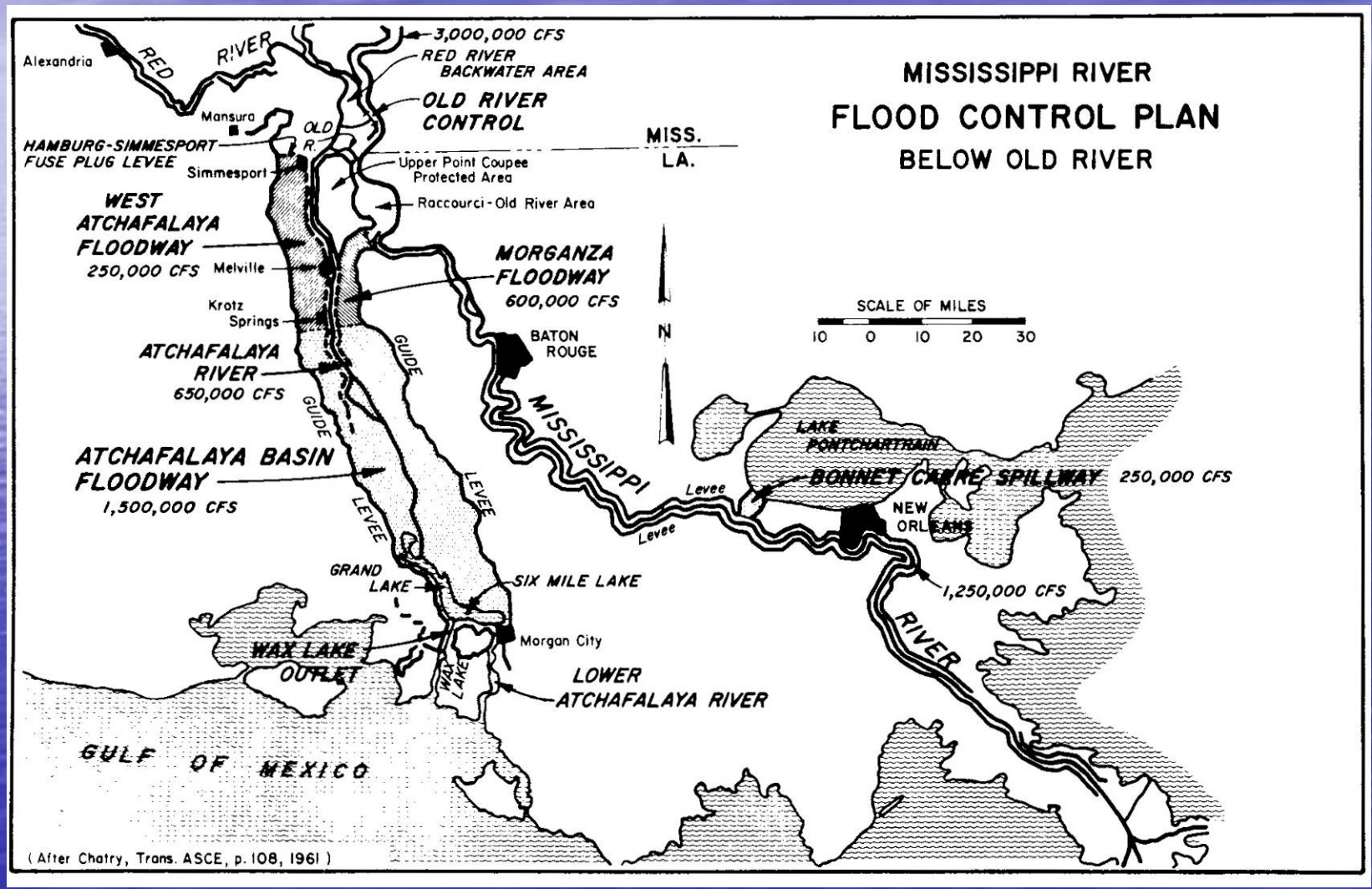


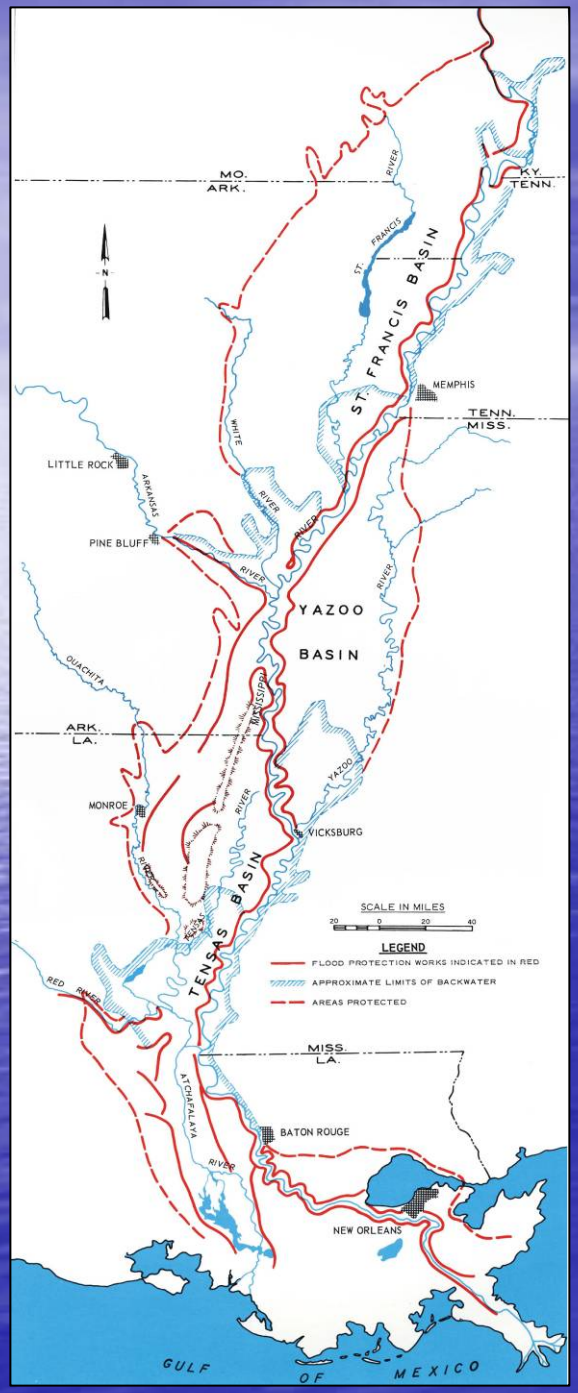
1927 FLOOD MAP

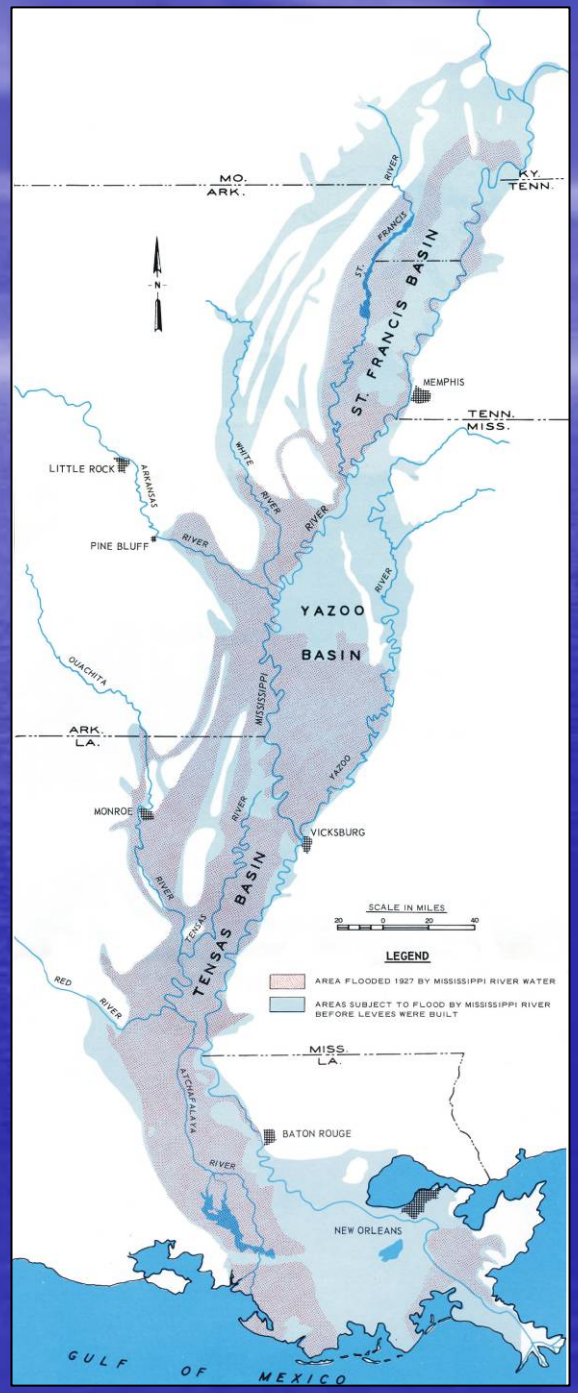
THE MISSISSIPPI RIVER AND TRIBUTARIES PROJECT

1928-1960

The Corps' Mississippi River and Tributaries Project -1928

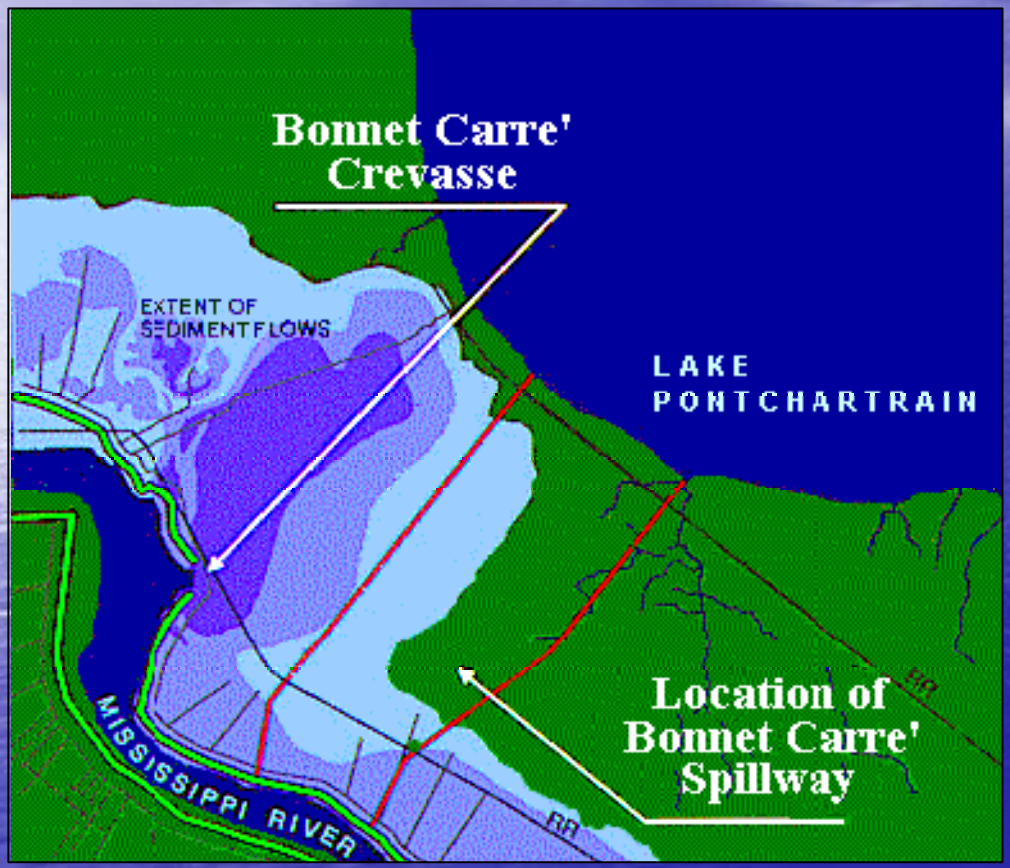






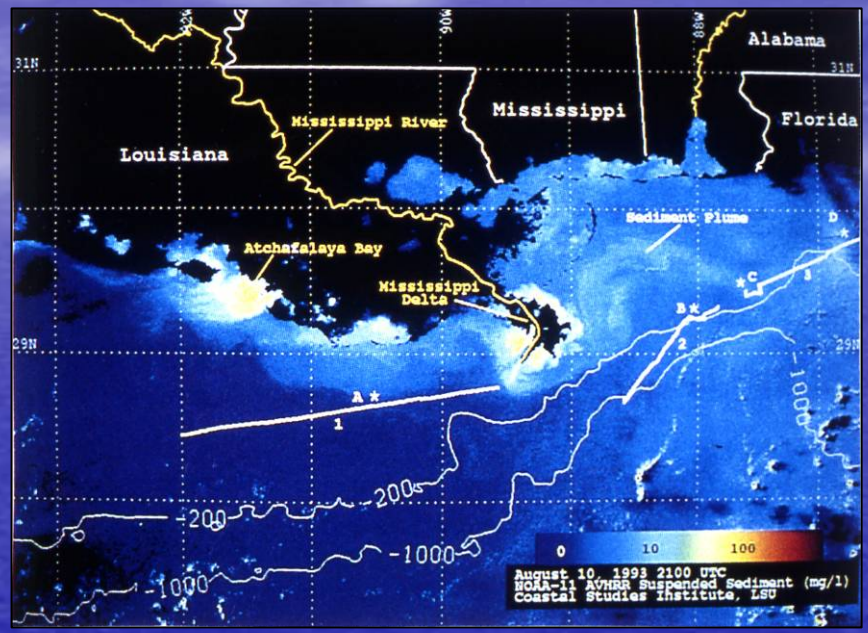
The Army Corps of Engineers began the MR&T flood control program in 1928. It took until 1960 to get all of the pieces constructed and in-place, at a cost of $8 billion. It almost failed catastrophically at the Old River Diversion Bypass structure in 1973.

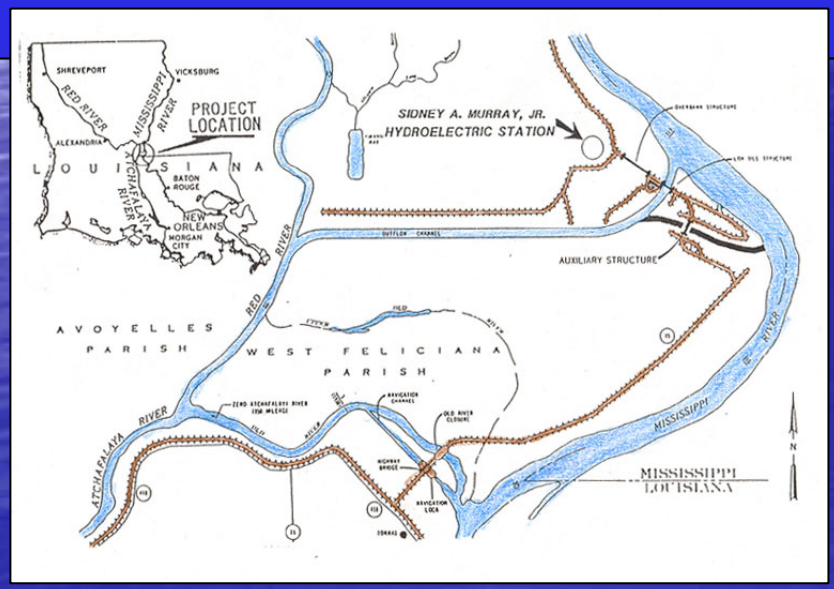
Bonnet Carre Spillway Bypass



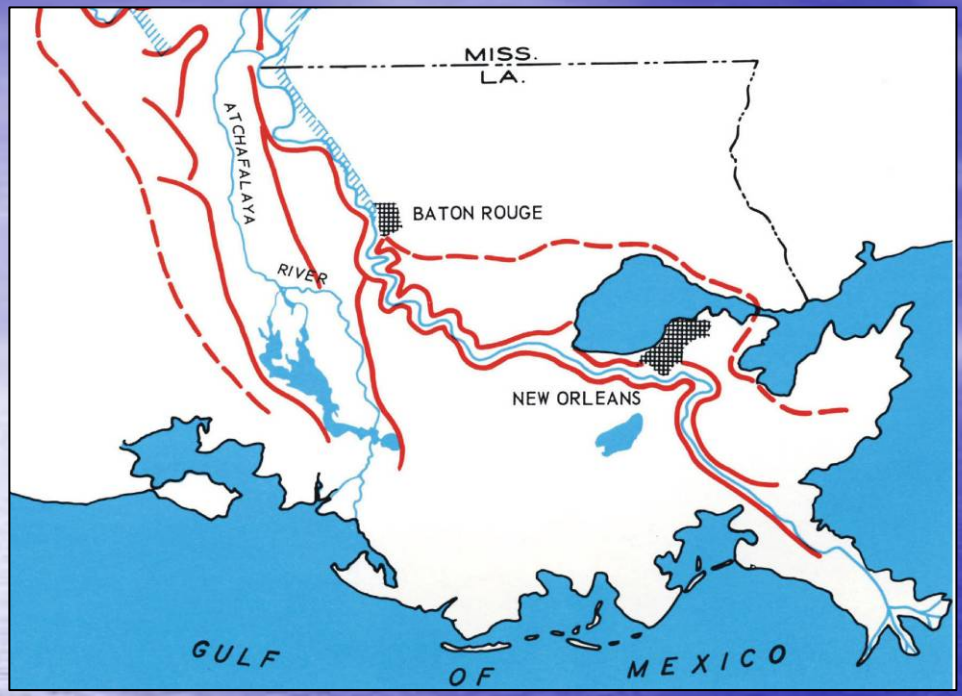
Intended to protect New Orleans from a Mississippi River flood

Atchafalaya River Bypass





The largest bypass on the River is the Atchafalaya Bypass at Old River, which is only half the distance to the Gulf of Mexico.

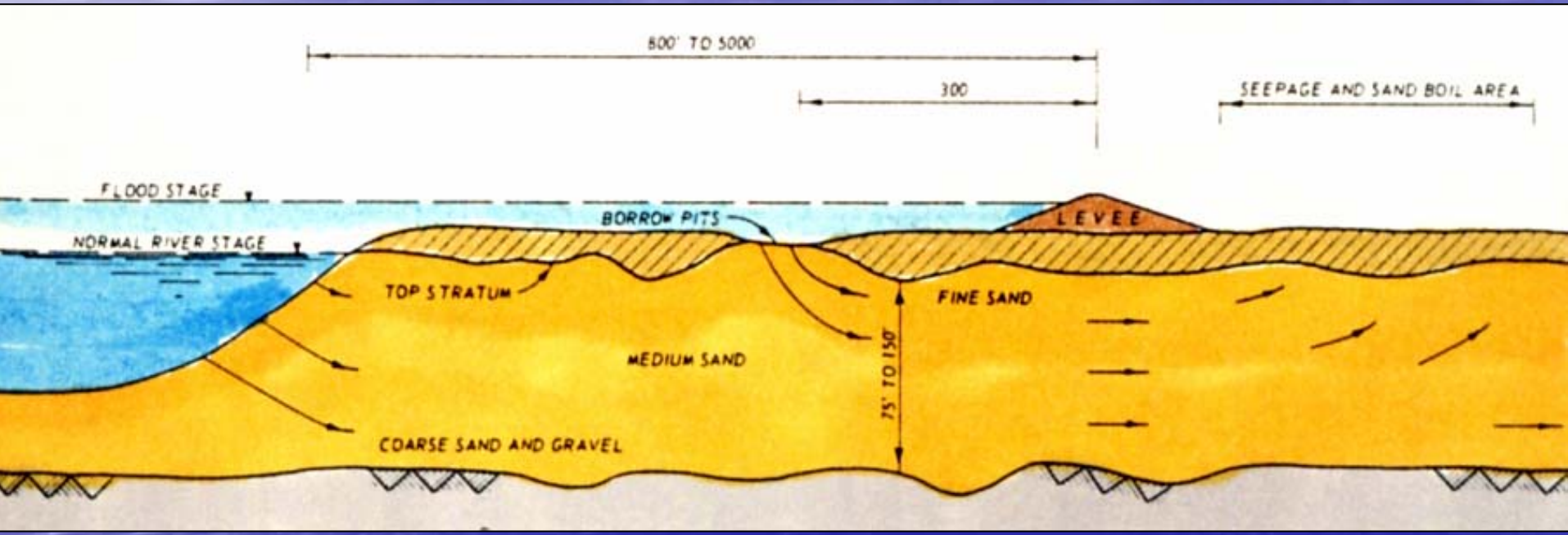


Atchafalaya River

The Atchafalaya River is both steeper than the Mississippi (3:1 ratio in bed slope) and shorter (225 kilometers to the Gulf of Mexico from the Red River entrance versus 480 kilometers for the Mississippi).

- Under natural conditions, the Mississippi River would probably have switched its course to the Gulf of Mexico via the Atchafalaya distributary between 1965 and 1975, if not for the levees.
- The Atchafalaya now drains about 30% of the combined flows of the Mississippi and Red rivers to the Gulf of Mexico.

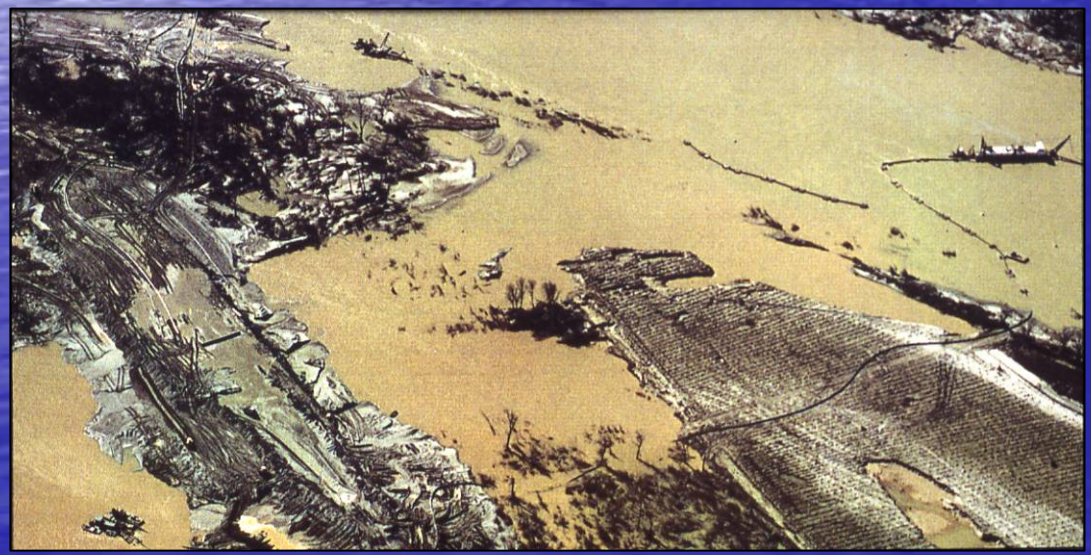
Model levee design standards established



- The theory of levees proposed to confine the river's mass in its main flow channel, encouraging scour during high flow.

1973

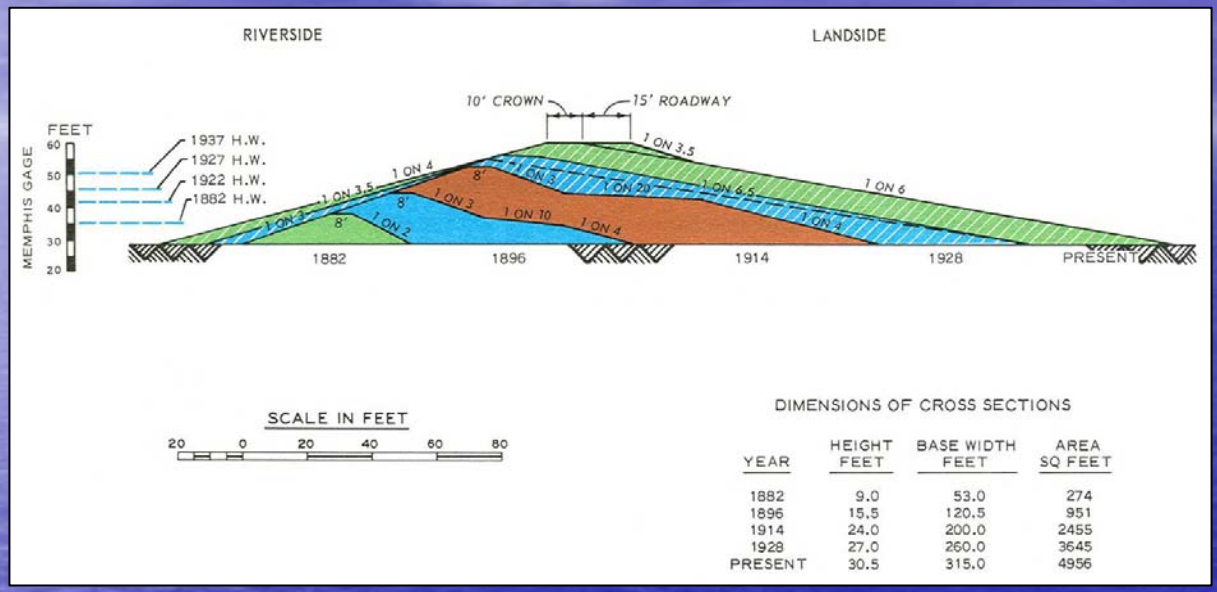
The Big Test....
and
Near Disaster



Levee Failures

- After the MR&T Project was completed in 1960, occasional levee failure occurred during sustained high flow events because of underseepage problems, toe scour, and overtopping

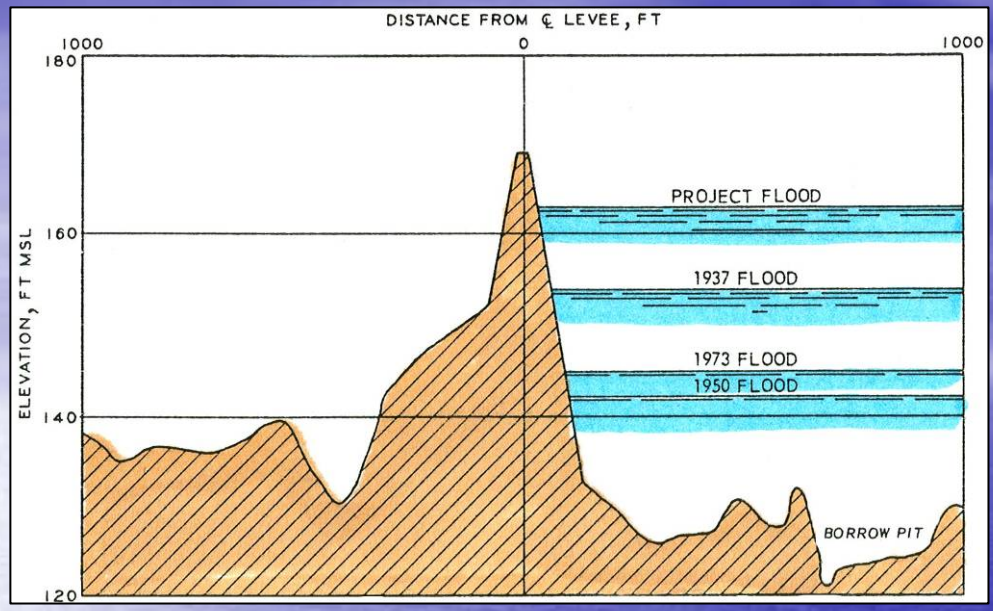
Levees have become legacy structures



DIMENSIONS OF CROSS SECTIONS

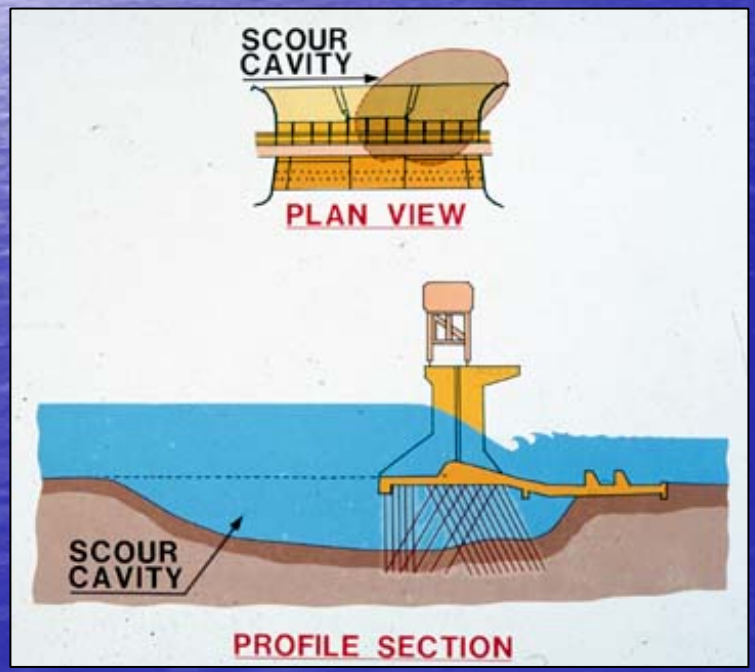
YEAR	HEIGHT FEET	BASE WIDTH FEET	AREA SQ FEET
1882	9.0	53.0	274
1896	15.5	120.5	951
1914	24.0	200.0	2455
1928	27.0	260.0	3645
PRESENT	30.5	315.0	4956

- Typical levee cross section in New Orleans area
- Louisiana levee topped out during the record 1973 flood



The Flood of 1973

- The Corps of Engineers came perilously close to losing the **Old River Diversion structure** connecting to the Atchafalaya Bypass during the 1973 flood. Its capacity was doubled afterward.



Collapsed Wing Wall on Old River Diversion Structure

- Scour cavities developed on both sides of the Low Sill Diversion Structure during the Flood of 1973.
- If these scour holes had conjoined, the structure would have failed, and a new Mississippi River channel would have been carved down the Atchafalaya River to the Gulf of Mexico.