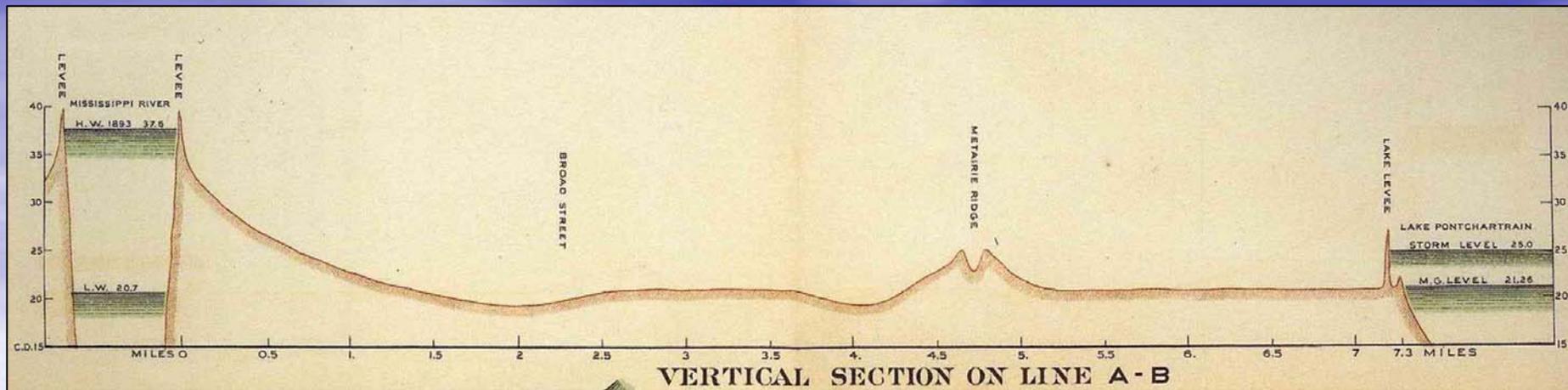


PART 2

NEW ORLEANS DRAINAGE CANALS



Cross section through New Orleans in 1895. The Mississippi River's natural levees form the highest ground in New Orleans. **Metarie** and **Gentilly Ridges** are recent distributary channels, lying about 3 to 6 feet above the adjacent ground. The earliest levees along Lake Pontchartrain (far right) were erected in the 1890s; then enlarged considerably in 1931-32, when the concrete seawall was built $\frac{1}{2}$ mile into Lake Pontchartrain and backfilled with the **Lakshore Landfill**.

Many Canals were filled or superseded by newer ones

- The **Old Basin**, or **Old Carondelet Canal** was excavated for drainage and navigation (row boats), between the City and Lake Ponchartrain. It ended at Basin Street, and was infilled in the **1920s**, when it became railroad tracks and Lafitte Avenue.
- The **New Basin Canal** was excavated in the early **1830s** in the American Sector, yellow fever killing 10,000 Irish immigrants. The New Orleans City Railroad paralleled this canal in post Civil War era.
- The **New Basin Canal** cut through Metarie Ridge; causing flooding of the downtown area in **1871**.
- The portion south of Metarie Ridge was filled in the **1930s**; and the remainder in the **1950s**, with the **Ponchartrian Expressway** replacing the old canal.

Drainage Canal Chronology

- The **Orleans Canal** was excavated in **1833** to convey water from Bayou Metarie. The Turnpike Road ran along the west side of this canal.
- The **Upper Line/17TH St. Canal** along the Orleans-Jefferson Parish boundary was excavated prior to **1849** – along the upper end of today's **17th St Canal**. The lower portion was excavated in **1857-58**, all the way to Bucktown, along Lake Ponchartrain
- In **1853** the **Jefferson & Lake Ponchartrain Railroad** was built along the Upper Line Canal



The **1878 Hardee drainage map** was compiled after a yellow fever epidemic the previous year, which brought to City's accumulated death toll to in excess of 100,000 people.

Drainage Canal Chronology

- The **1853** Ponchartrain Harbor Map shows brackish water tidal influx zone around the mouth of Bayou St. John, extending westward, to the New Basin Canal.
- The **Upper Protection Canal** was excavated around **1857-58** out to Lake Ponchartrain. This became the **17th Street Canal** (the street was renamed Palmetto Avenue in 1894)
- By **1863** there were a series of east-west **feeder canals** serving Bayou St. John from the west side
- By **1863** there were a series of NNE trending drainage canals in St. Bernard Parish



All 36 miles of drainage canals in the Lakeview and Gentilly areas are shown in 1878: 17th Street, New Basin, Orleans, Bayou St. John, London, and the Lower Line Protection Levee.

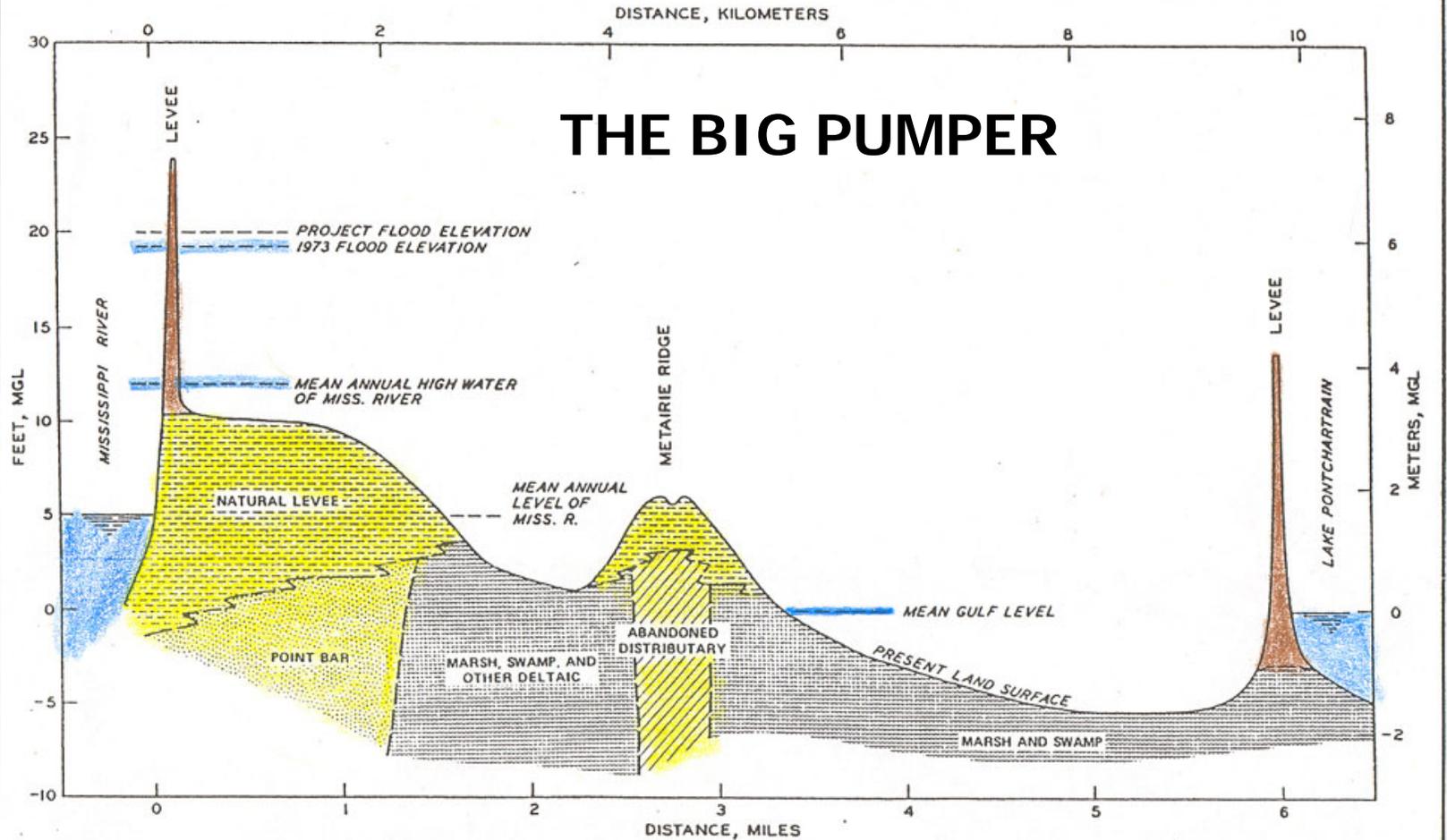
Drainage Canal Chronology

- The **upper London Avenue Canal** was constructed in the **1860s**, north of Bayou Gentilly. A steam-powered draining machine near the intersection of London and Pleasure Street dumped this water into the cypress swamp near what is now Dillard University, north of Gentilly Ridge.
- The **lower London Avenue Canal** was extended out to Lake Ponchartrain sometime between **1873-78**

EARLY WARNINGS

- In **1871**, the New Orleans City Surveyor **W.H. Bell** warned of the potential dangers posed by the big outfall drainage canals
- He told city officials to place pumping stations on the lakeshore, otherwise *"heavy storms would result in water backup within the canals, culminating in overflow into the city."*

THE BIG PUMPER



Much of New Orleans lies below sea level, Lake Pontchartrain, and the Mississippi River, making it particularly vulnerable to flooding. Mississippi levee 24.5 feet; Pontchartrain levee 13.5 feet.

Drainage Commission - 1896

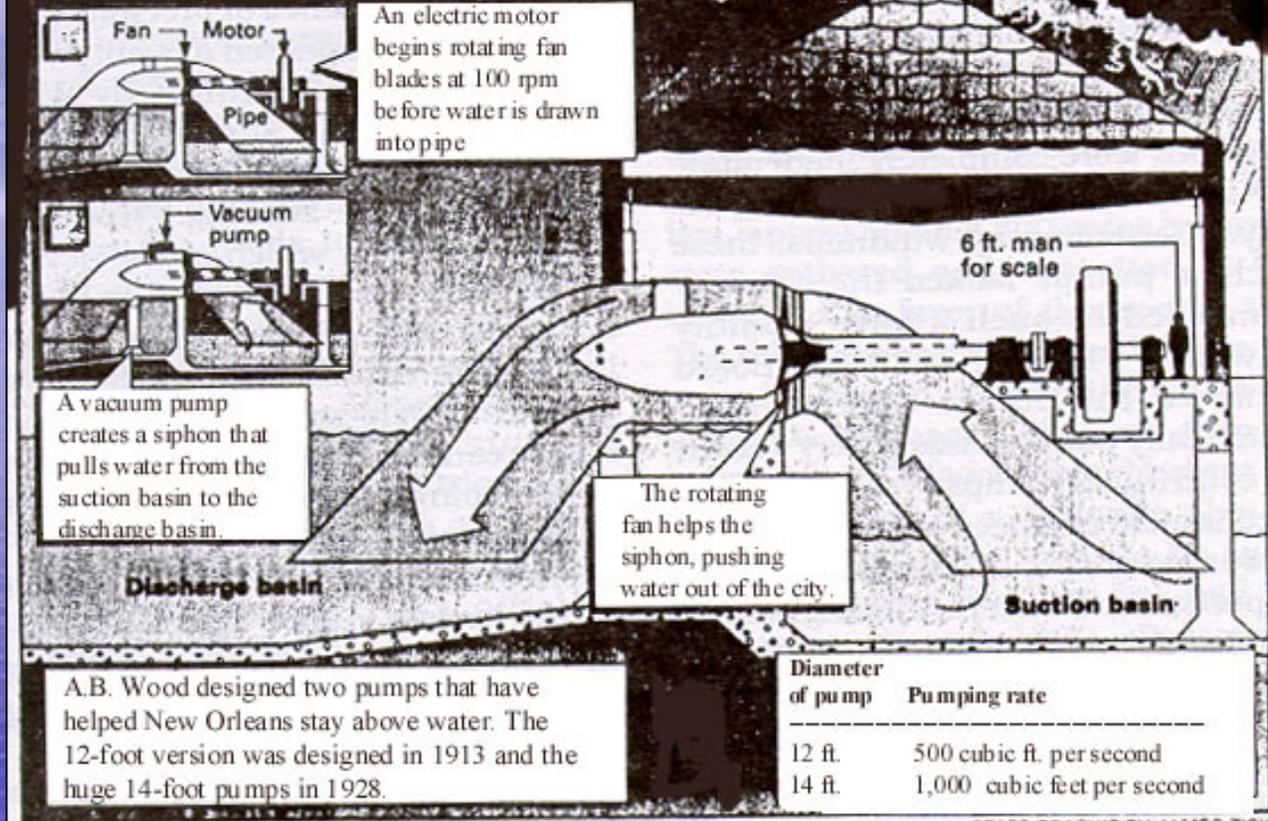
- The Louisiana legislature created a drainage commission in **1896** to deal with drainage of New Orleans
- This subsequently became the **New Orleans Sewerage and Water Board** in **1899**.
- By 1915 there were 70 miles of canals and three new pump stations in place. By 1926 the system cost \$27.5 million
- Eventually, this system has expanded to 172 miles of drainage canals, 90 miles of which are covered.



A. Baldwin Wood was a young S&WB engineer who designed the enormous screw pumps, 12 to 14 feet in diameter, which run on 25 Hz electric power using 20 ft diameter dynamos. The City began by installing 11 Wood pumps in **1915** for a cost of \$159K. These replaced the old steam powered paddle wheel pumps.

Keeping New Orleans dry

The A.B. Wood Screw Pump revolutionized the draining of the city



This 1920s drawing shows the arrangement of a Wood screw pump, which uses a powerful siphon action to lift water into the drainage canals, where it flows by gravity to Lake Ponchartrain. The City's 21 pump stations can lift 47,000 csf of water. Prior to Katrina, it had only been overwhelmed on a few occasions, in **1978** and again, in **1995**.

Pumping the floodwater out ...

Once New Orleans' breached levees are repaired, the city's complex system of levees, floodwalls, canals, pumps and locks can be used again to make the below-sea-level city dry.

THE SYSTEM

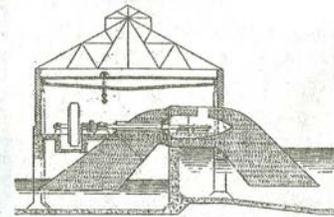
Pumps at drainage pumping stations throughout the system move runoff water from storm sewers to Lake Pontchartrain; can manage 29 billion gallons daily.

2 Pumps
Draw water



FIRST PUMPS

Original pumps, known as Wood screw pumps, were designed in 1913 by Albert Baldwin Wood; about 50 still in use.



Canal-side pumping stations (left)
Connected to drainage system; pump rain water into canals

Canal-spanning pumping stations (right)
Similar to locks; raise level of water in canal so it can flow easily into lake.

4 Locks
Allow water from canal to flow into lake; may be opened if water level in lake is lower than that in canal or to let small vessels into canal; keep lake water from backing up.

1 Collection
Stormwater collects in box culvert, flows into pumping station.

TYPICAL MODERN PUMP

Vertical pumps have replaced some original pumps; lower part is submerged in water in canal or storm sewer system.

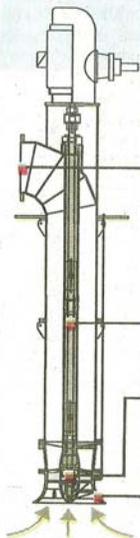
Water discharge
Capacity: Most used in New Orleans can pump up to 250,000 gallons per minute.

Height: 30-40 feet

Drive shaft: Connected to diesel or electric engine; powers impeller.

Impeller: Propeller-like device moves water up pump.

Suction bell: Water enters pump here.



CRACKS IN THE WALL

First built in 1897, the aging system was breached in at least three places.

17th St. Canal

About 300-foot breach created when storm surge from lake topped floodwall and moved levee wall horizontally about 20 feet.

London St. Canal

About 300-foot breach in floodwall.

Industrial Canal

Possibly two breaches, 100 feet and 500 feet.



Note: Floodwalls, levees not to scale

Closed roads hamper evacuations

- 1 Interstate 55** is partially submerged
- 2 Lake Pontchartrain Causeway** is impassable
- 3 Sections of Interstate 10 bridge** are torn off

SOURCES: Knight-Ridder Tribune; Associated Press; NOAA; AccuWeather, National Hurricane Center, National Weather Service; Insurance Information Institute; Army Corps of Engineers; U.S. Geological Survey; Patterson Pump Co.; Linda Hall Library of Science, Engineering and Technology; Engineering News

New Orleans also employs **vertical pumps** with impellers to lift water from subterranean storm drains to the drainage canals.

1915 FLOOD ENTERED CITY VIA THE DRAINAGE CANALS

- In **1915** a powerful hurricane lifted the water level in Lake Ponchartrain to 6 feet above mean gulf level.
- The drainage canals were overtopped and much of the city flooded
- The City's new pump system was overwhelmed when the power stations were flooded
- **275 people** were killed in the flooding

RESPONSE TO 1915 and 1947 OVERTOPPINGS

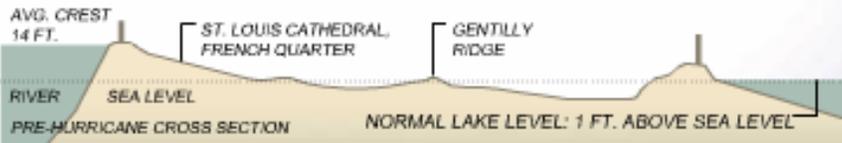
- After the **1915 flood**, Sewerage and Water Board General Superintendent George Earl ordered the levees along the drainage canals to be raised.
- After several of these heightened drainage canal levees were overtopped in **1947**, the state's congressional delegation asked the federal government to assist in protecting the city

FEDERAL INVOLVEMENT

- Federal involvement in the drainage canals began in **1955** with approval of the **Lake Ponchartrain and Vicinity Hurricane Protection Project**
- Clash of cultures and goals between local levee districts, the S&WB, and the Corps of Engineers ensued.
- The Corps preferred gates at the mouths of the canals, but S&WB and many residents opposed, fearing they would malfunction, inhibiting outflow of storm water.

40 YEAR BATTLE

- The issue of how to address improvement of the drainage canals dragged on for almost 40 years.
- In the meantime, intense residential development encroached upon the drainage canals, beginning in **1955**.
- Congress decided the issue in **1992**, ordering the Corps to go with heightened levees able to withstand a **Category 3 storm** with 12 ft tides and 130-mph winds.



Water levels between the city and Lake Pontchartrain evened out late Wednesday, stopping the rise of water in the city. Normally, the city is protected by levees from the lake, since much of it is below the lake's water level.

-  **Pumping station**
 All currently offline
 The extent of flooding was determined using an infrared satellite image taken at noon on Tuesday. Water continued to rise after the image was taken.
-  **Flooded areas**
 As of noon Tuesday

-  **Major levees and flood walls**
-  **Smaller levees, flood walls and roads that block flow of water**

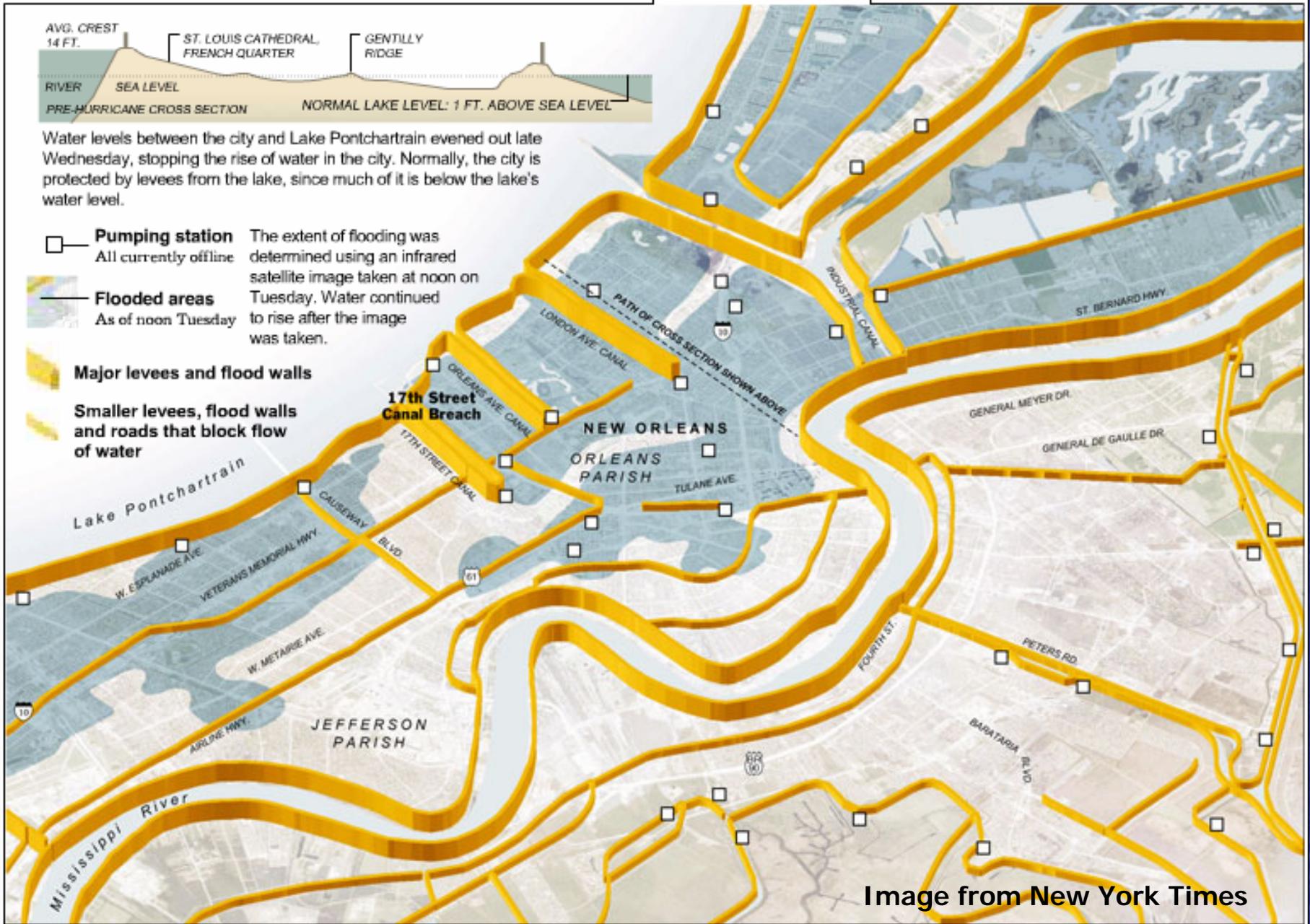


Image from New York Times

A complex network of levees protected the city from flooding, but it quickly failed on August 29, 2005, when water levels rose.

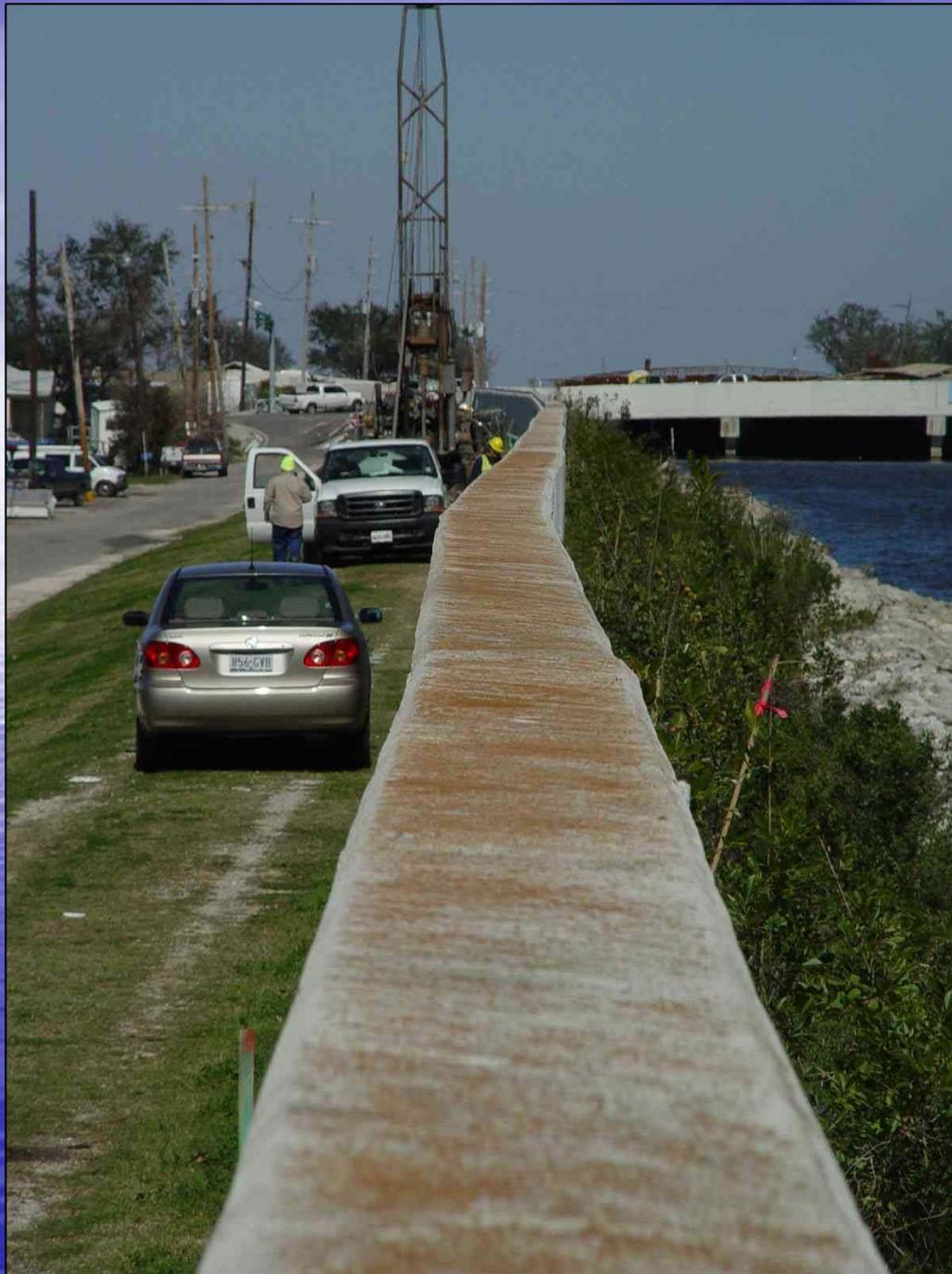


Flood Walls were constructed on the crowns of drainage canals and the Inner Harbor Navigation Canal to accommodate functionality during high storm surges. The walls in the Lakeview and Gentilly Districts topped out at +14 ft above MGL.

Flood Walls

Prior to Hurricane Katrina, the drainage canals feeding into Lake Ponchartrain never exceeded a flow height of **7 feet above MGL**

This shows deflection of the western 17th Street Canal flood wall, opposite the August 29, 2005 break of the eastern wall, near the Hammond Highway Bridge.



Meanwhile - Land Reclamation

- In **1924** the state commissioned the Orleans Levee Board to construct new levees along Lake Ponchartrain
- In the **1930s** the levee board constructed a concrete stepped seawall one-half mile out into Lake Ponchartrain, and backfilled this with **1,800 acres of "made ground."**
- This development solidifies the Lakeshore area as a desirable bedroom community with yacht harbors, parks, and pleasant summer breezes



View of New Orleans from above Lake Ponchartrain in the mid 1950s, when the Lakeview and Gentilly neighborhoods adjacent to the lake were under intense development.

