

Post Katrina Hurricane Storm Damage Risk Reduction System -- Progress and Remaining Challenges

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US Army Corps of Engineers
BUILDING STRONG®



Agenda

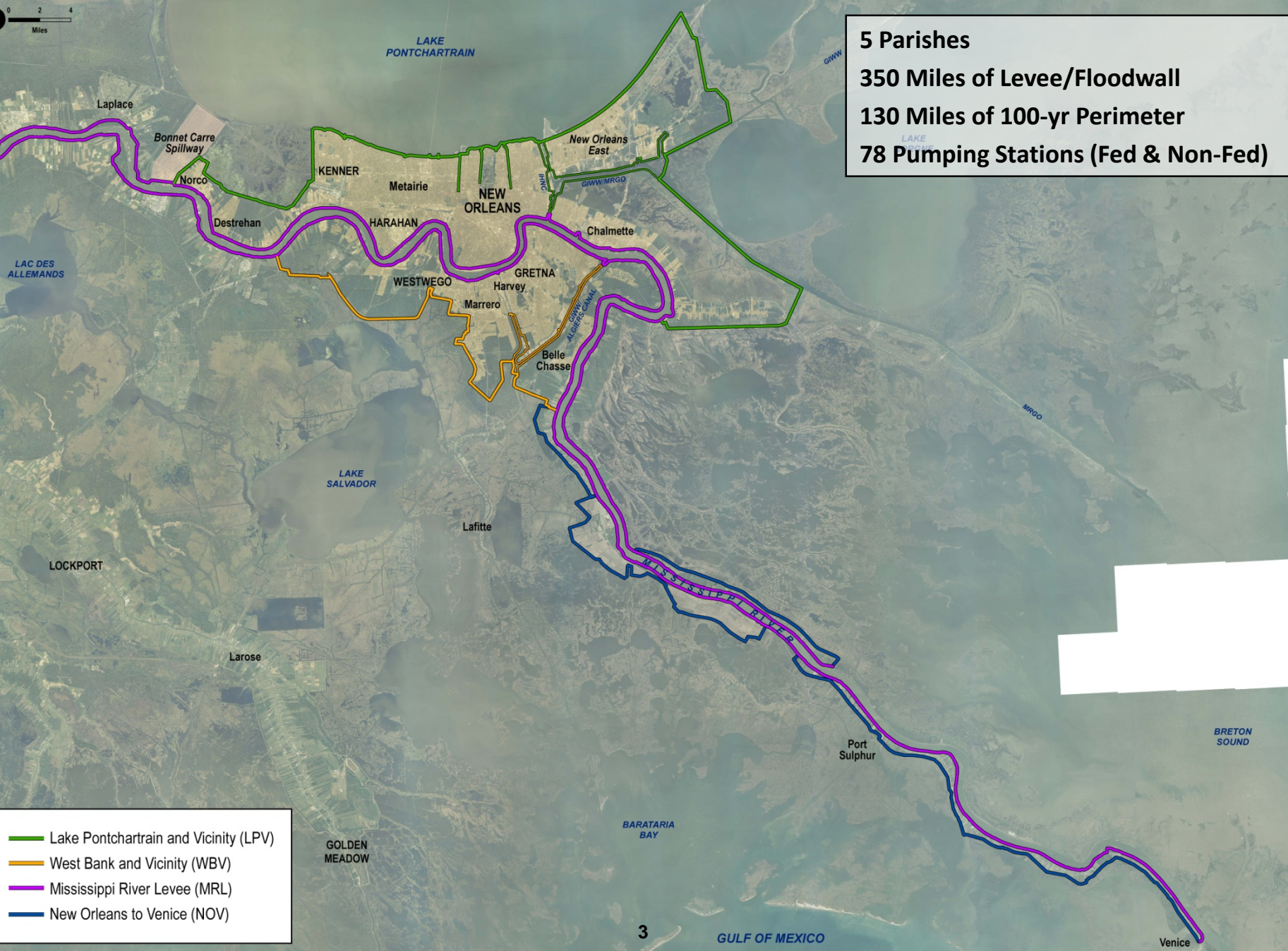
- Flooding Risk to Greater New Orleans
- Characterization of the Hazard Uncertainty
- Integrated System Improvements
- Future Challenges



HURRICANE AND STORM DAMAGE RISK REDUCTION SYSTEM

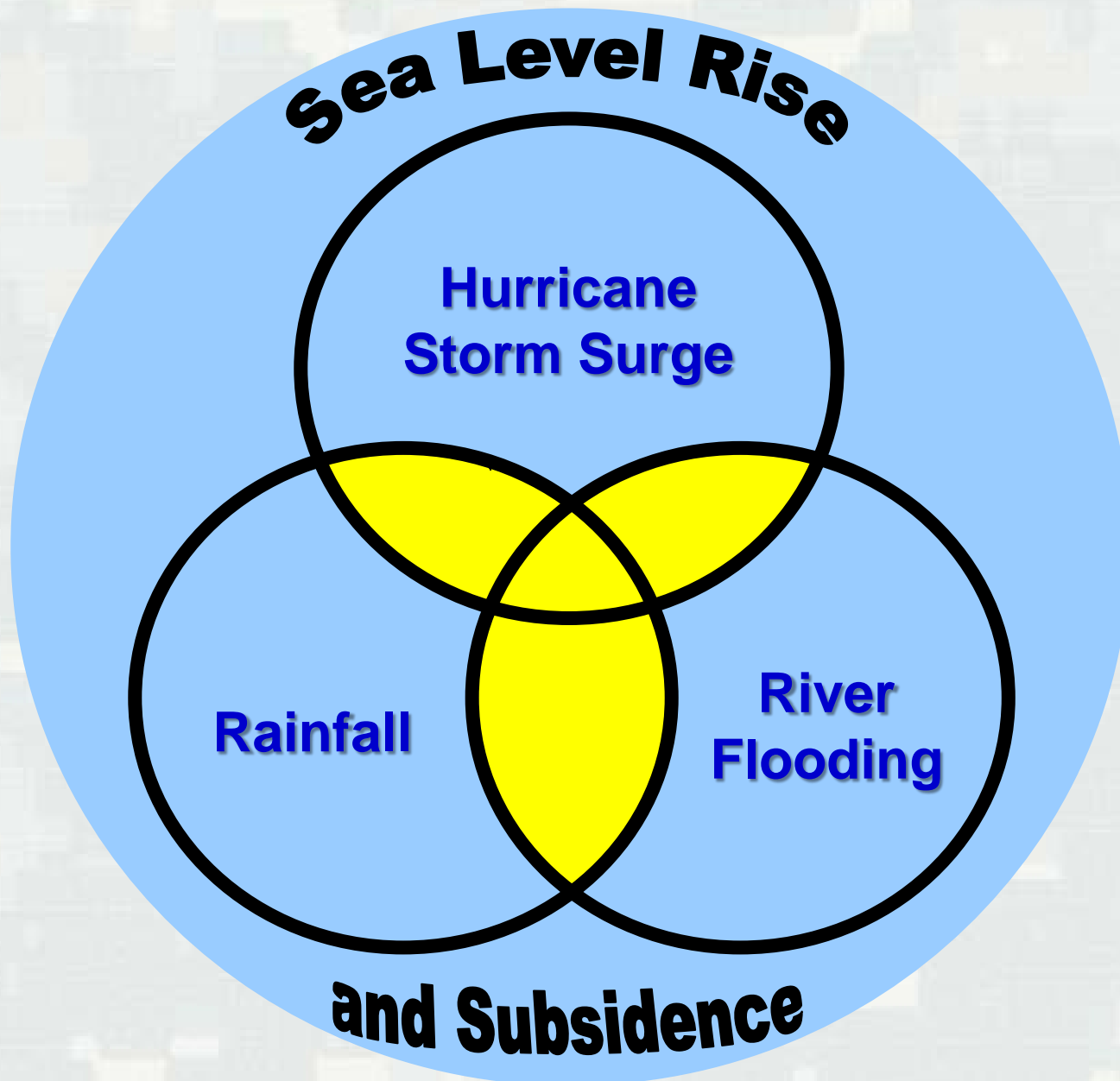
Lake Pontchartrain and Vicinity (LPV), West Bank and Vicinity (WBV), Mississippi River Levee (MRL), and New Orleans to Venice (NOV)

5 Parishes
350 Miles of Levee/Floodwall
130 Miles of 100-yr Perimeter
78 Pumping Stations (Fed & Non-Fed)



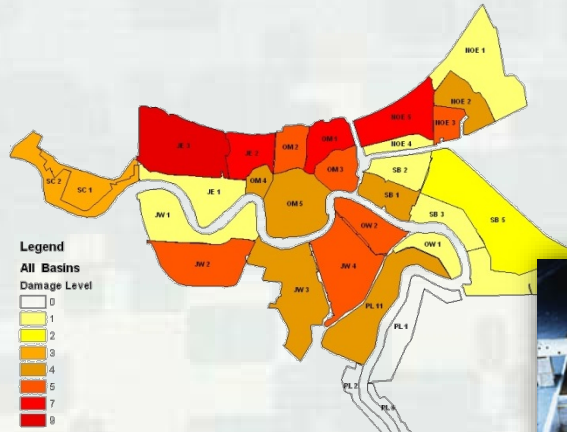
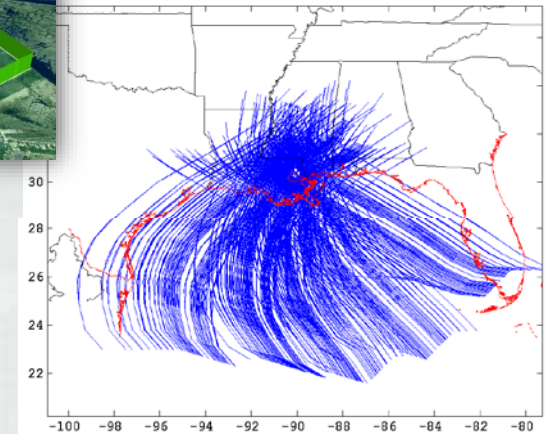
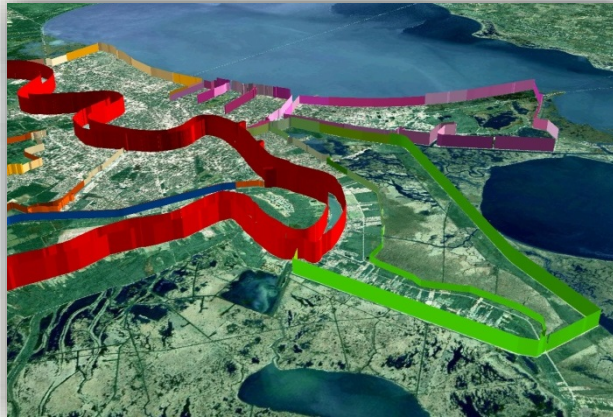
- Lake Pontchartrain and Vicinity (LPV)
- West Bank and Vicinity (WBV)
- Mississippi River Levee (MRL)
- New Orleans to Venice (NOV)

Major Flood Risks in Coastal LA



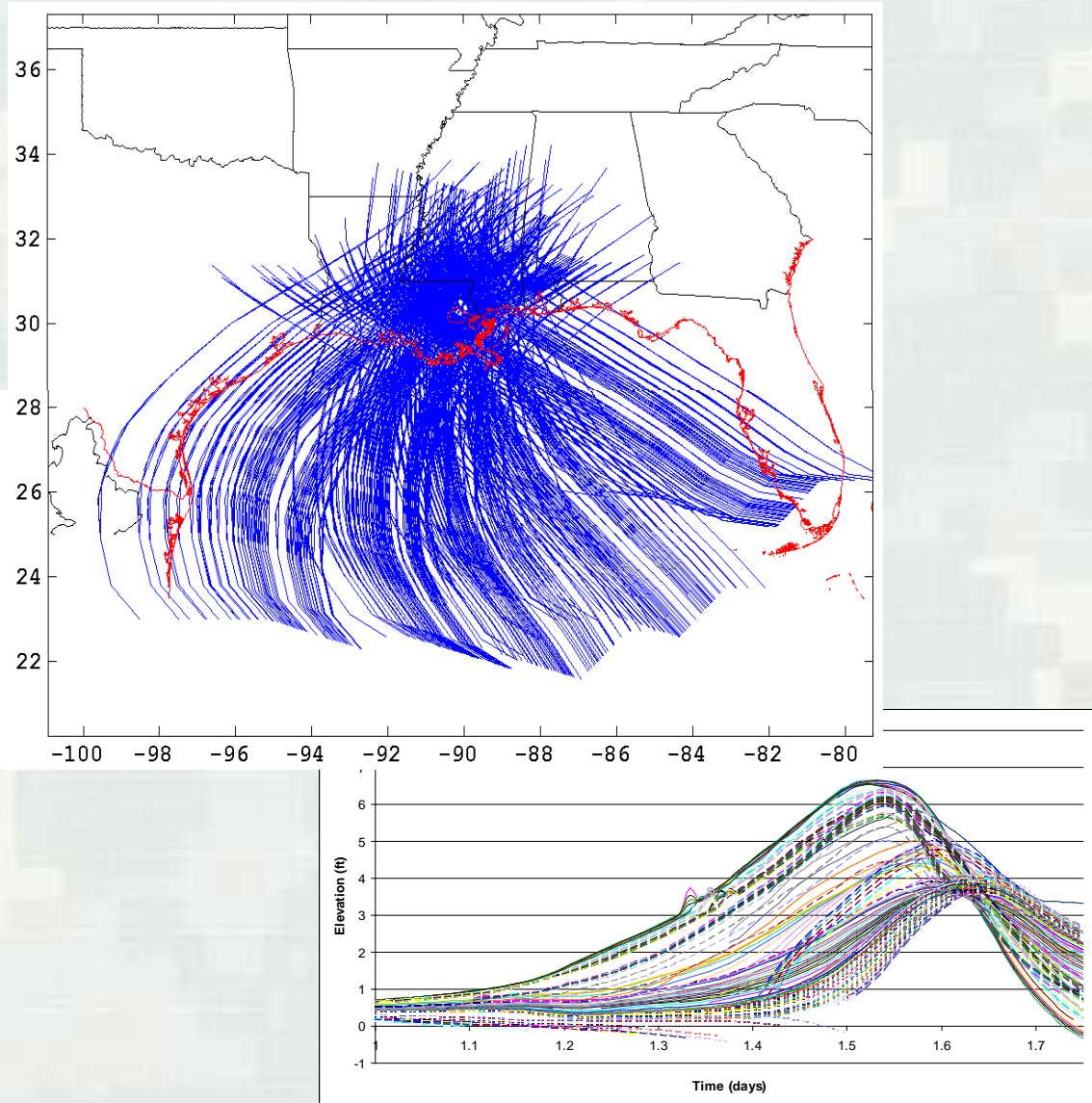
USACE's Actions for Change – 4 Themes

- *Comprehensive systems approach*
- *Risk-informed decision making*
- *Communication of risk to the public*
- *Professional and technical expertise*



Characterization of the Hazard Uncertainty

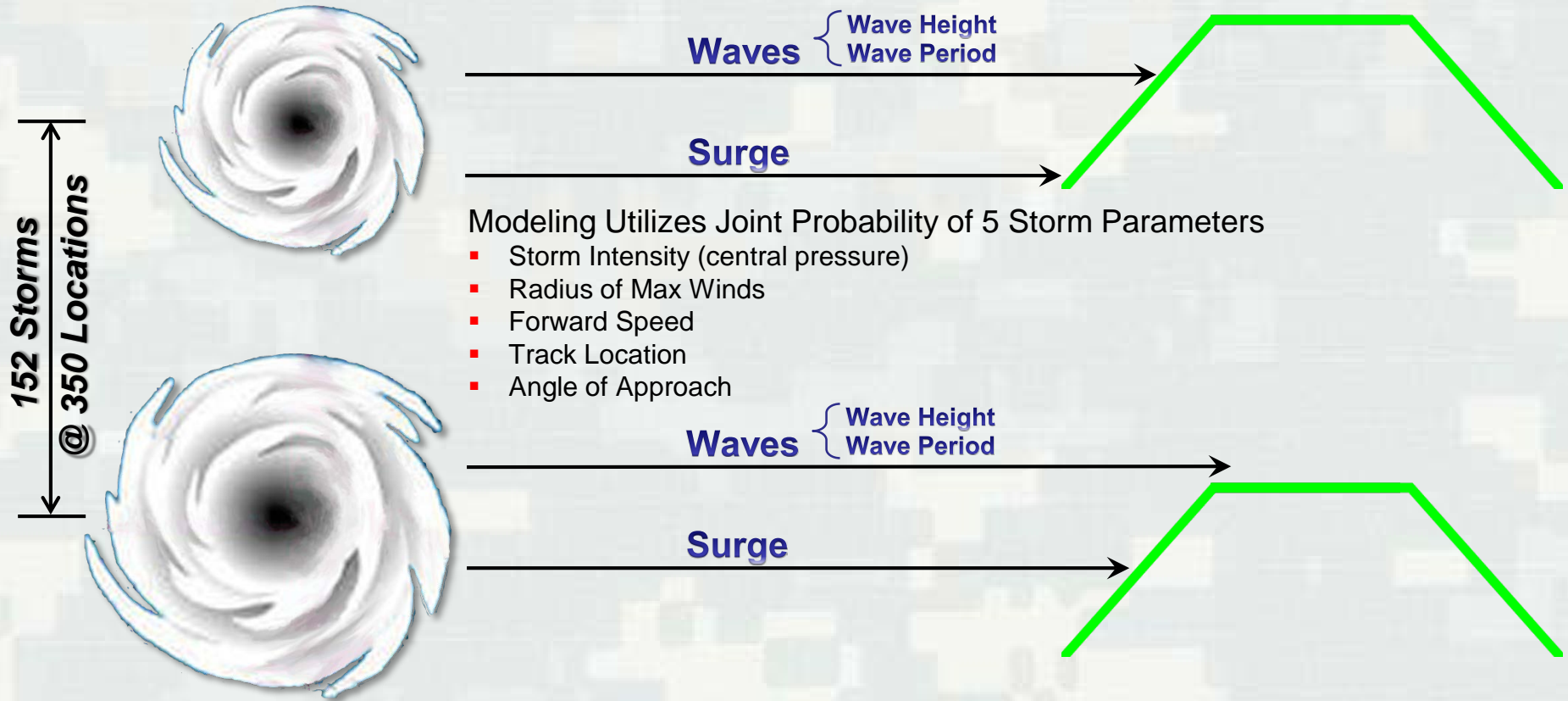
Characterization of the Hazard Uncertainty



- 3 HSDRRS Geometries
 - Pre-Katrina
 - Current (1 June 07)
 - 100-year LORR (~2011)
 - 152 storms
 - Added 76 synthetic storms
 - Created 152 total storms
 - 25 yr to 6,500 yr return period in the Gulf Coast
 - 350+ features
 - Floodwalls
 - Levees
 - Pumps Stations
- **62,928 Hurricane Hydrographs**

HSDRRS – Establishing 1% Levee Elevations

152 Storms Modeled from 25 yr to 5,000 yr



Storm Modeling → 1% Surge, 1% Wave Height & 1% Wave Period: assume all occur at same time at 350 locations

+
Wave Overtopping Analysis → 90% assurance for overtopping (0.10 cfs/ft)
→ 50% assurance for overtopping (0.01 cfs/ft)

1% Elevation, Top of Levee

System Improvements

Deliver the Greater New Orleans HSDRRS Mission

Challenges

- *“The hurricane protection system in New Orleans and southeast Louisiana was a system in name only” – IPET*
- Mandate to deliver \$14.6B construction program within budget and on schedule
- Form design criteria, program cost estimate, acquire funding
- Intense scrutiny / oversight
- New governances
- NEPA compliance
- Deliver a comprehensive system
- LPV: Construction in progress for 40 years
 - ▶ 70% construction complete
 - ▶ Perimeter substantially in place but many segments below authorized design grade
- WBV: Construction in progress for 14 years
 - ▶ 40% construction complete
 - ▶ Large segments of perimeter unconstructed



Deliver the Greater New Orleans HSDRRS Mission

Enablers

- Administration / Congressional commitment
- Fully funded program
- National / Regional Corps capabilities
- Local partners and stakeholders capabilities
- **NEPA Alternate Arrangements**
- Full host of acquisition strategies
- Favorable bidding climate
- International Support



Best Practices: System Program Management

- Acquisition Strategy
 - ▶ Design Build / Cost Plus Contracts
 - ▶ Best Value Source Selection
 - ▶ Early Contractor Involvement (ECI)
 - ▶ Program Management Support Contract
- Construction Materials
 - ▶ Government Furnished Borrow
 - ▶ Supply Contracts for Sheet Piles and Borrow
- Improved Techniques
 - ▶ Value Engineering – systems study complete
 - ▶ Pile Load Tests – in advance of contract award
 - ▶ Press Pile, Spiral welded piles
 - ▶ Deep soil mixing, sand blanket and wick drains
- Leverage International, National & Regional Resources



HSDRRS Technical Applications and Innovations



Deep Soil Mixing

- Largest ever deep soil mixing application in US
- 1.7 million cubic yards of land treated
- 500,000 tons of cement used
- 5.3 mile stretch
- 8 rigs used



Wick Drains

- Largest ever wick drain application in USA
- 250,000 wicks

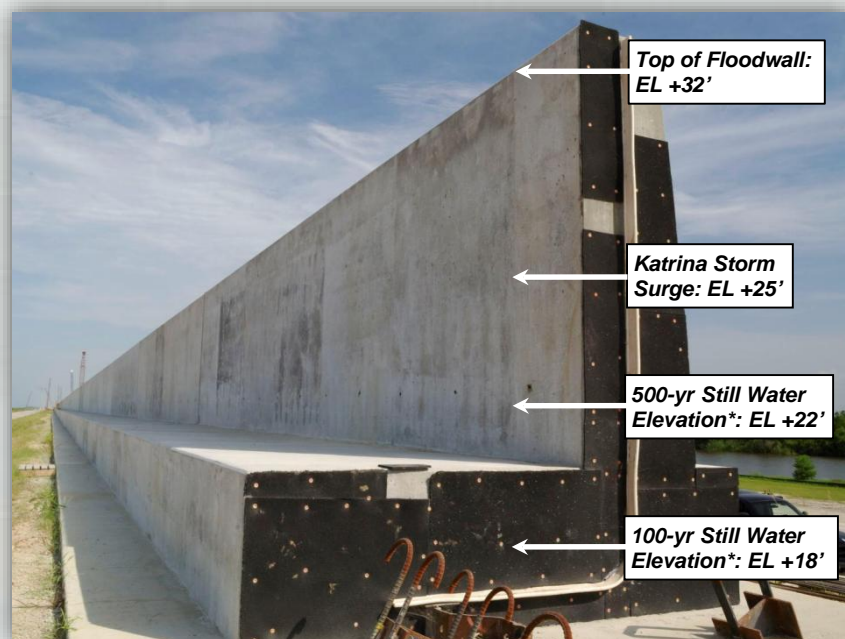
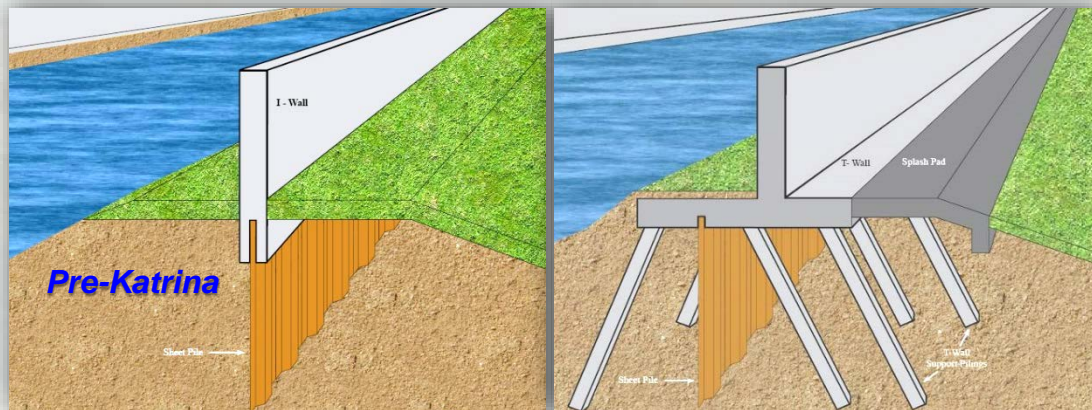


Sand Blanket

Over 1 Superdome of Clay
(4.9 mil cy) Required

Design Improvements

T/I wall design



Interim Closure Structures

Orleans Ave. Canal



London Ave. Canal



17th St. Canal



- *All structures completed June 2006*
- *Provide interim 100-yr level of risk reduction*

Pump Station Improvements

Fronting Protection



Safe House



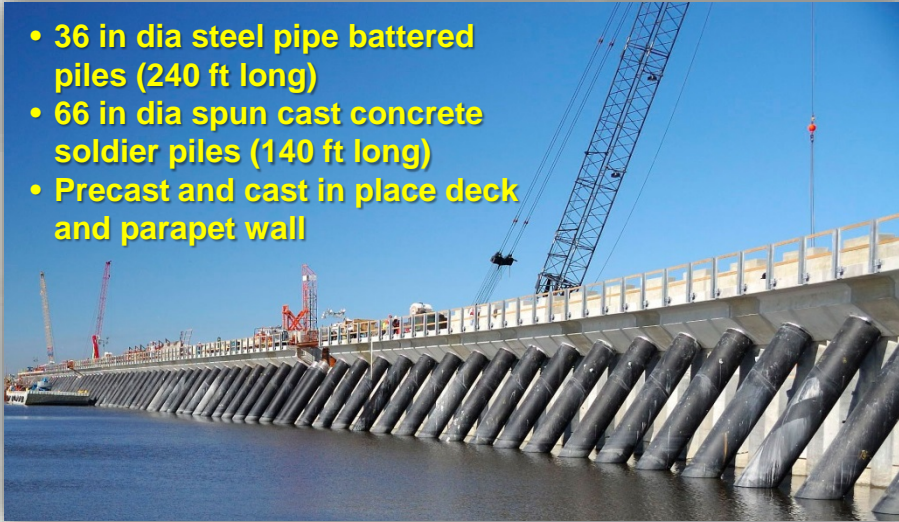
- 5 new safe houses built
- 5 existing safe houses improved / hardened

Integrating Man Made and Natural Systems



IHNC Lake Borgne Surge Barrier

- 36 in dia steel pipe battered piles (240 ft long)
- 66 in dia spun cast concrete soldier piles (140 ft long)
- Precast and cast in place deck and parapet wall



- \$1.3 B Delivery cost
- Design-Build Cost Reimbursable



- 1.8 mile span
- 150 ft sector gate and barge gate
- 54 ft vertical lift gate



Winner of 2014 ASCE
Outstanding Civil Engineering
Achievement

West Closure Complex



- Largest drainage pump station in the world – 19,140 cfs
- Largest sector gates in US – 225 ft clear width
- Removed 26 miles of levees and floodwalls from the first line of defense
- ~\$1 B Delivery cost
- Early Contractor Involvement (ECI)

A Stronger System Than Ever Before

LAKE PONTCHARTRAIN



17th St.



Orleans



London



Seabrook

Total System Openings: 493

Navigable Openings: 11
Roadway Openings: 144
Railroad Openings: 45
Access Openings: 134
Drainage Openings: 159

- Developed new HSDRRS hydraulic, geotechnical and structural design criteria.
 - Floodwalls and hardened structures built for 2057 hydraulic conditions
 - Pre-Katrina system: 200 miles
 - Post-Katrina 100-yr system: 130 miles
- 35% shorter perimeter exposed to surge



IHNC Surge Barrier

Bayou Verret



Bayou Segnette

LAKE AOUATCHE

Harvey Floodgate



Hero Canal

Kenner Canal (7 linear miles)

GIWW/Algiers Canal (17.5 linear miles)

West Closure Complex



Caernarvon

GREATER NEW ORLEANS HSDRRS CLOSURES/INTERIOR REACHES

- HSDRRS (Perimeter Reaches)
- HSDRRS (Interior Reaches)
- Closure Structures/Gates



Remaining Work

HSDRRS Remaining Work



\$850 M
Est. complete: 2017

*Permanent
Pump Stations*



\$340 M
Est. complete 2016

*Mississippi River / HSDRRS
Co-located Levees*



~\$1.38 B
Est. Complete: 2021

SELA Interior Drainage



\$414 M
Est. complete 2018

Armoring



\$295 M
Est. complete 2019

*Environmental
Mitigation*



*New Orleans to Venice /
Non-Federal Levees*

Permanent Canals Closures and Pumps

**Contract
Award Value:
\$695 M**

17th St. Canal

Estimated Substantially
Complete: Sep 2017



Estimated
Substantially
Complete:
July 2017

London Ave. Canal

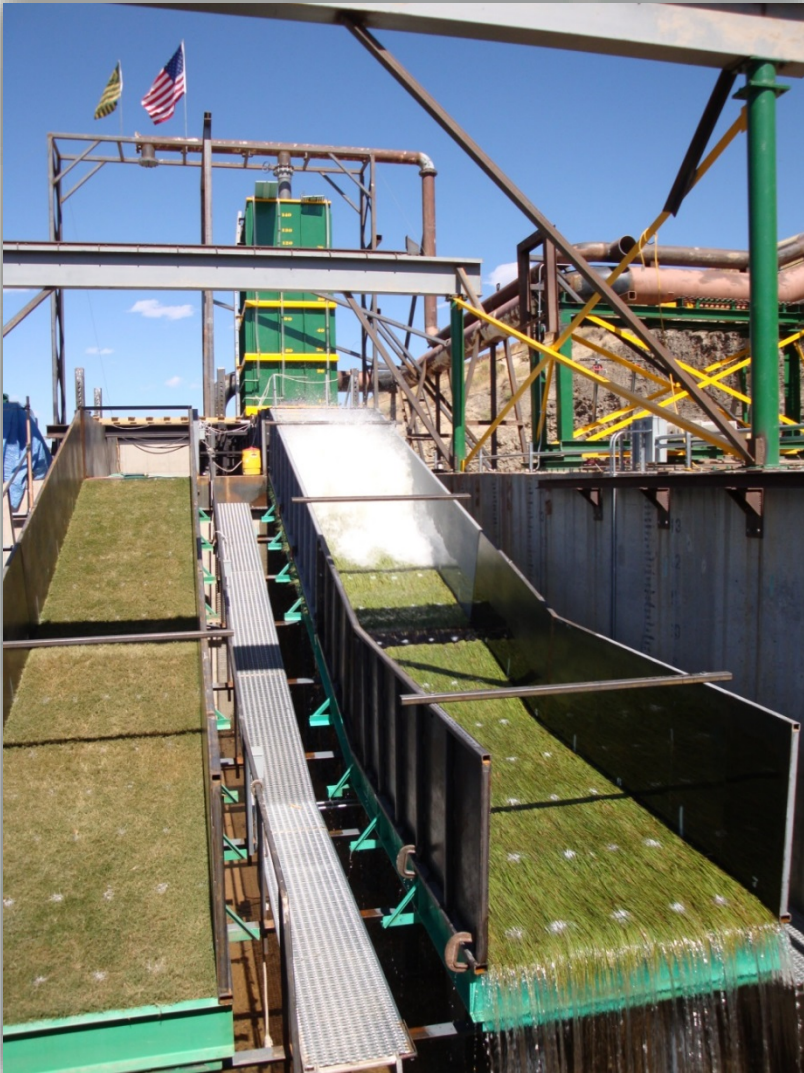


Estimated Substantially
Complete: Apr 2017

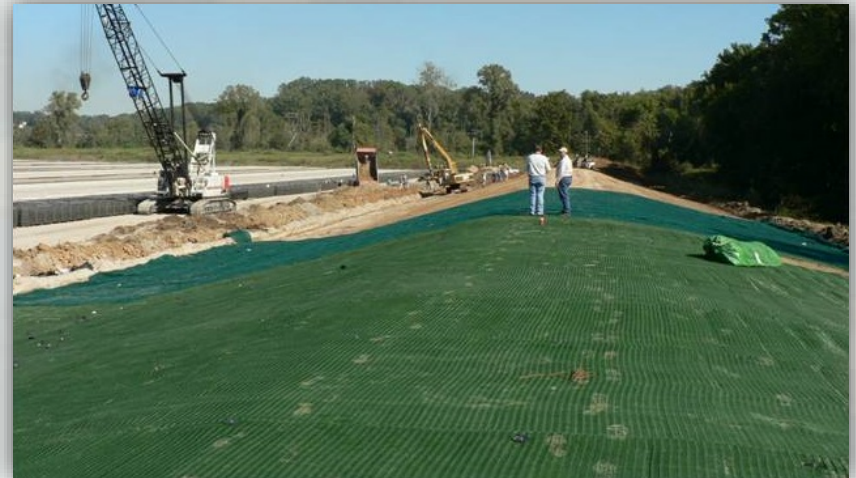
**Orleans
Ave. Canal**



Armoring



Wave Overtopping Testing



Turf Reinforcement Mat

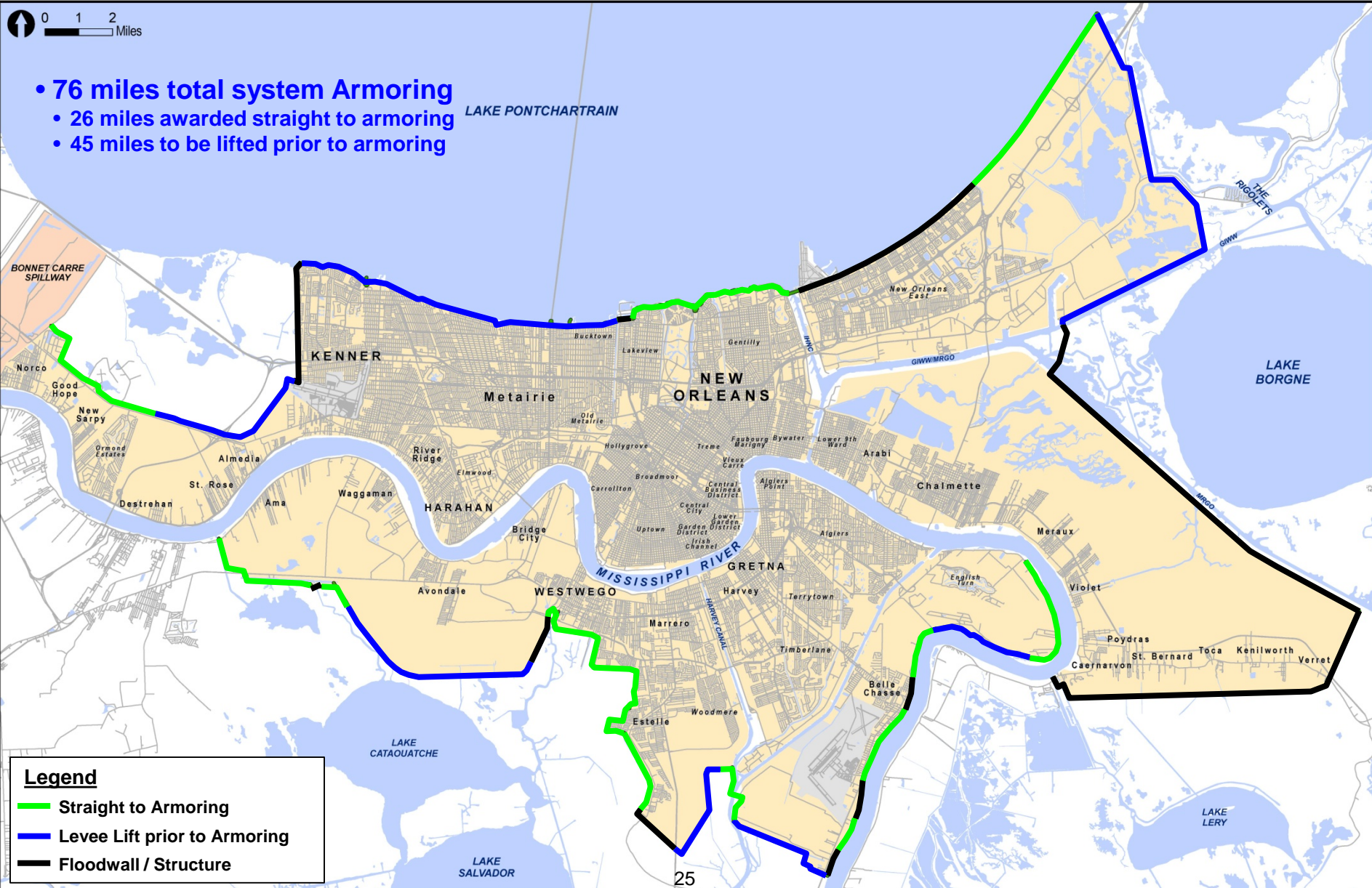


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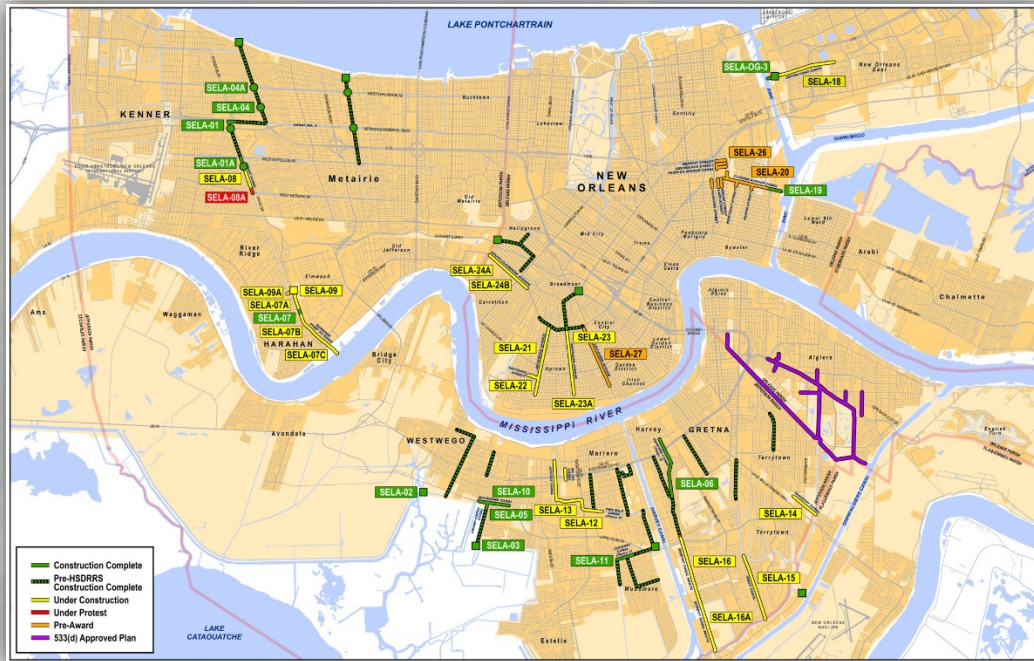
Armoring / Levee Lift Status

0 1 2 Miles

- 76 miles total system Armoring
- 26 miles awarded straight to armoring
- 45 miles to be lifted prior to armoring



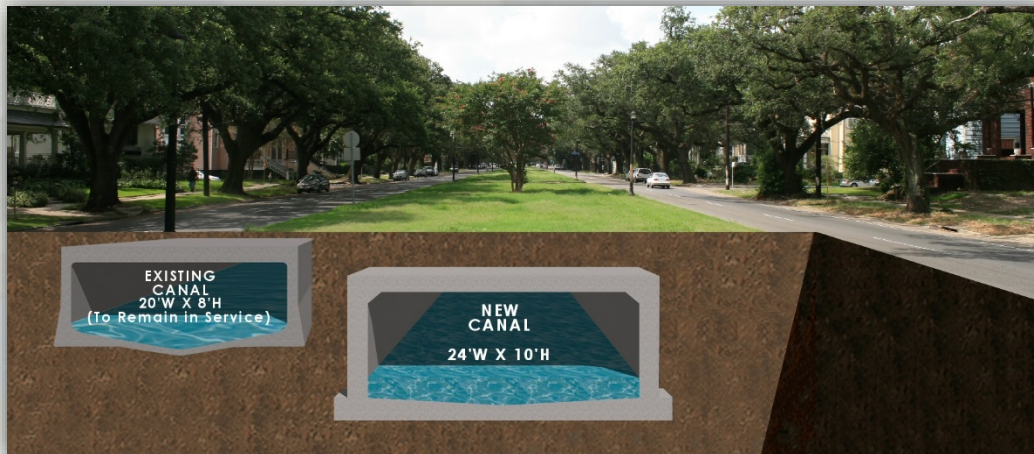
Southeast Louisiana Interior Drainage Flood Control



Program Cost: ~\$1.4 B



S. Claiborne Avenue Canal – Phase I



Soniat Canal – W. Napoleon to Lynnette

HSDRRS Environmental Mitigation

Impacts (2,295 acres)

- LPV – 1,179 acres
- WBV – 1,116 acres

Program Cost:
\$295 M

Current Plan

- 3 Mitigation Bank projects
- 10 Corps constructed projects

Challenges

- Lack of in-basin mitigation bank credits for all impacted habitats
- Some Corps Constructed projects potentially require condemnation for investigation/construction



Bottomland Hardwoods Wet



Swamp



Marsh

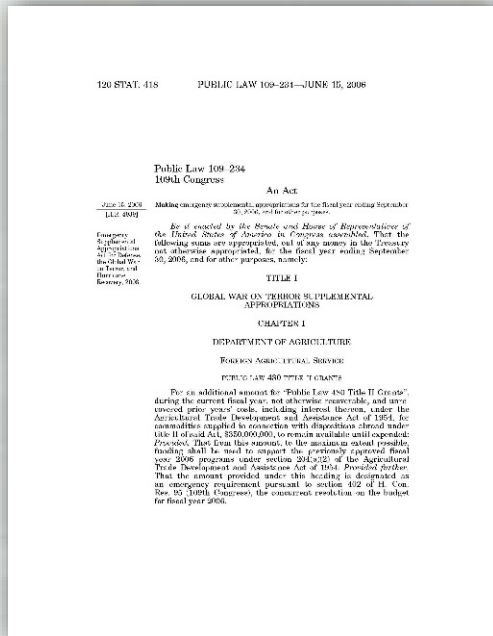


Bottomland Hardwoods Dry

Final Thoughts

Then and Now

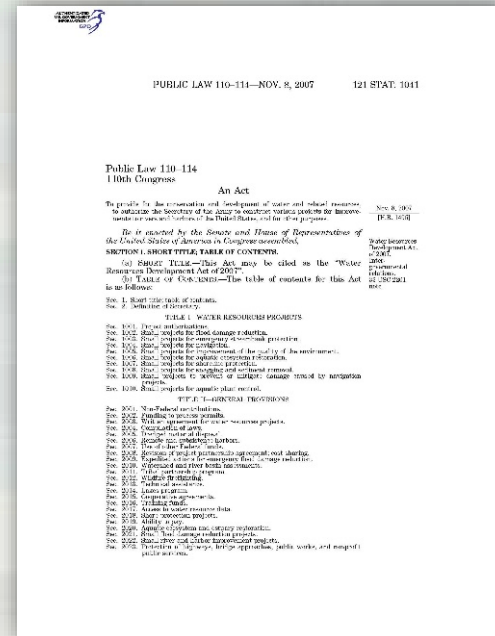
PL 109-234



HSDRRS Authorization

- No economic justification
- Environmental compliance concurrent with work
- Technically feasible

WRRDA 2014



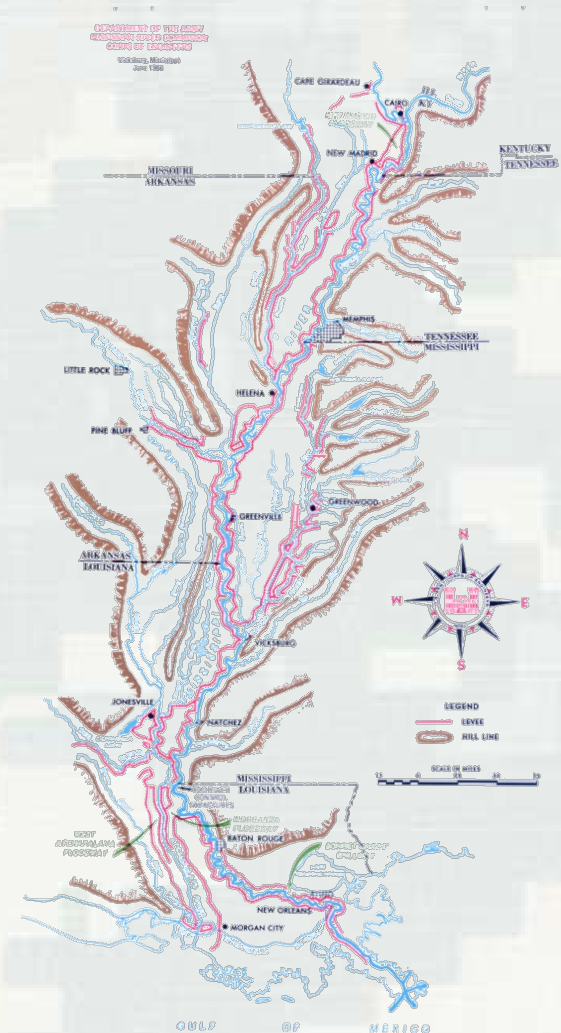
Future levee lift authority

- Economically justified
- Environmentally compliant
- Technically feasible

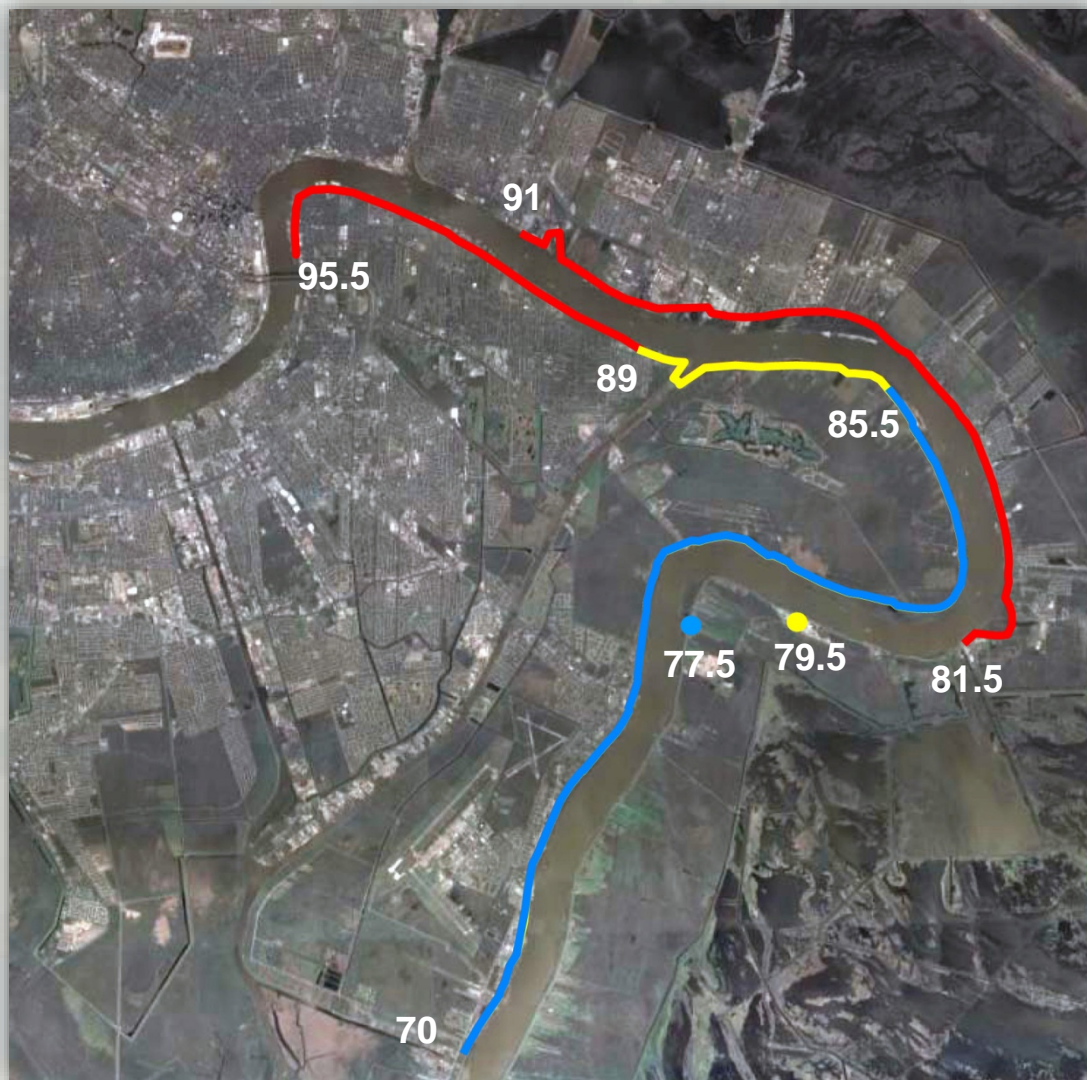
Mississippi River and Tributaries (MR&T) Project

Integrated System Still Under Construction

- Resulted from Great Flood of 1927
 - ▶ One of the worst natural disasters in the United States
 - ▶ More than 23,000 sq miles were submerged
 - ▶ Hundred of thousands of people displaced
- Authorized through the Flood Control Act of 1928
- Largest flood control project in the world
- Protects 36,000 sq mile lower Mississippi Valley
- 4 Major Elements:
 - ▶ Levees for containing flood flows
 - ▶ Floodways for the passage of excess flows past critical reaches of the Mississippi River
 - ▶ Channel improvement and stabilization
 - ▶ Tributary basin improvements
- \$14 B invested into the MR&T since 1928
- Prevented \$639 B in damages since 1928
- Prevented \$234 B in damages in 2011



MRL Future Needs



Miles of work required as crossover point moves upriver in future years

2011 Crossover – Current

West Bank RM 85.5	East Bank RM 77.5	Total
15.5 miles	0 miles	15.5 miles

2021 Crossover

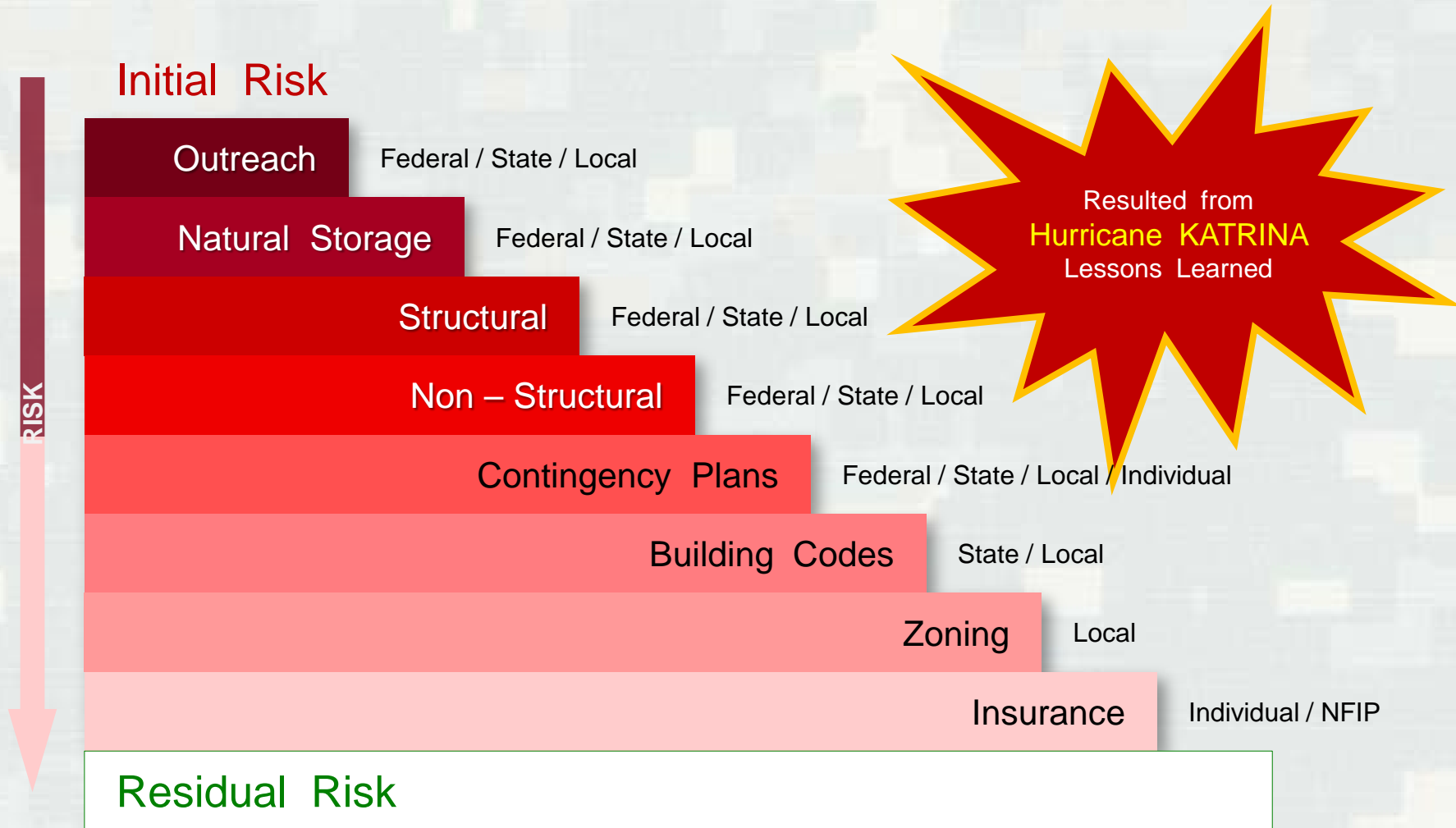
West Bank RM 89	East Bank RM 79.5	Total
3.5 miles	0 miles	3.5 miles

2057 Crossover

West Bank RM 95.5	East Bank RM 91	Total
6.5 miles	9.5 miles	16 miles

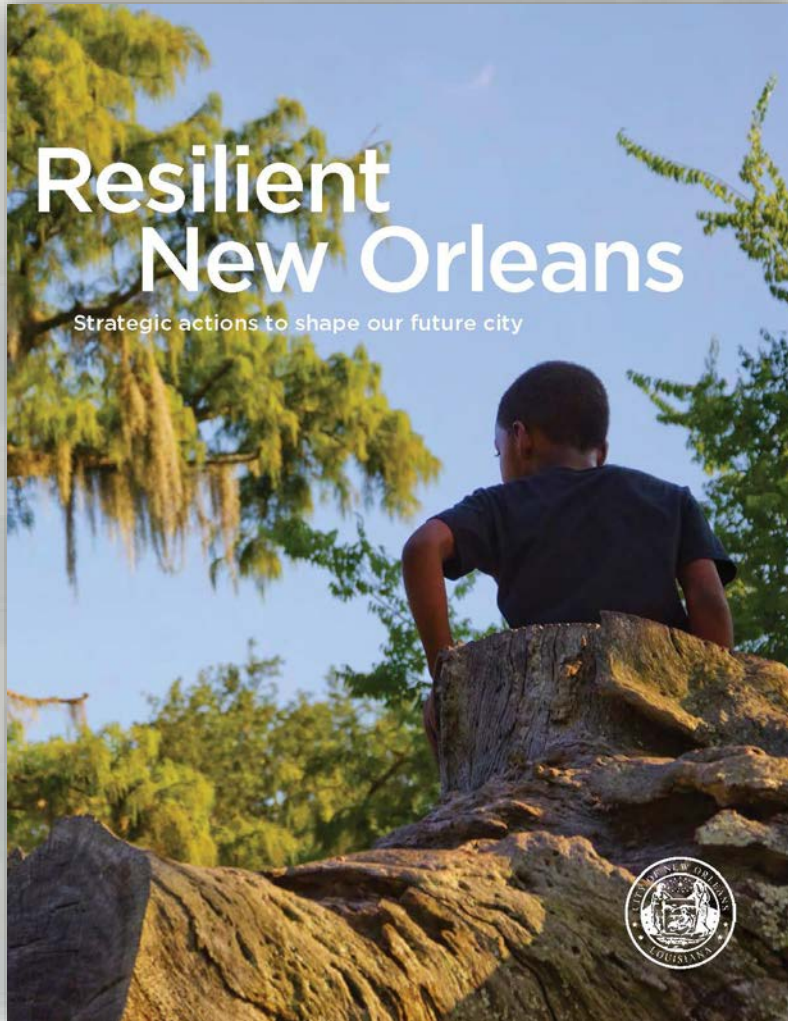
Risk and Risk Communication

“Driving Down the Risks with an Informed and Engaged Public”



All Stakeholders contribute to reducing risk !

Resilient New Orleans



▪ **Challenges Faced**

- ▶ *Hurricanes (Katrina, Rita, Ike, Gustav, Issac)*
- ▶ *BP Oil Spill*
- ▶ *Great Recession*

▪ **Future Challenges**

- ▶ *Climate Change / Sea Level Rise*
- ▶ *Land Subsidence*
- ▶ *Coastal Erosion*
- ▶ *Lack of equity and opportunity*

▪ **Resilience**

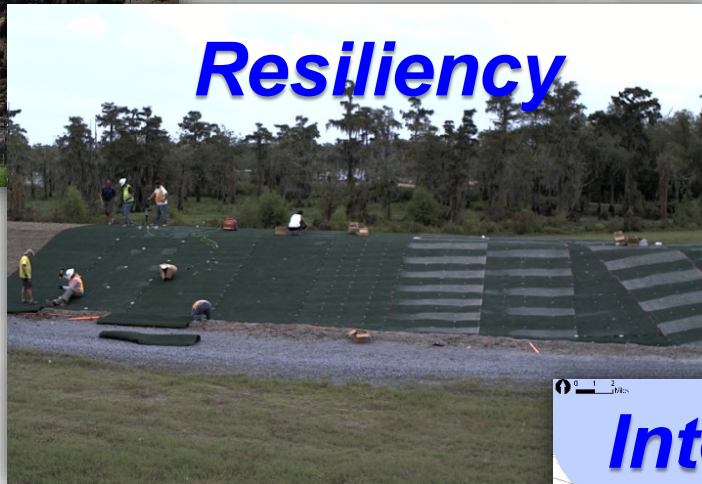
- ▶ *Strike balance between human needs and the environment*
- ▶ *Combat violence, poverty and inequality*

Future Challenges

Levee Lifts



Resiliency



Integrated System



A large construction site at sunset. The sky is a deep orange, and the silhouettes of numerous tall cranes dominate the background. In the foreground, several vehicles, including cars and trucks, are visible, some with their headlights on. The overall scene is one of intense industrial activity during the 'golden hour' of the day.

Discussion / Questions

St. Bernard Floodwall Construction – Southern Reach