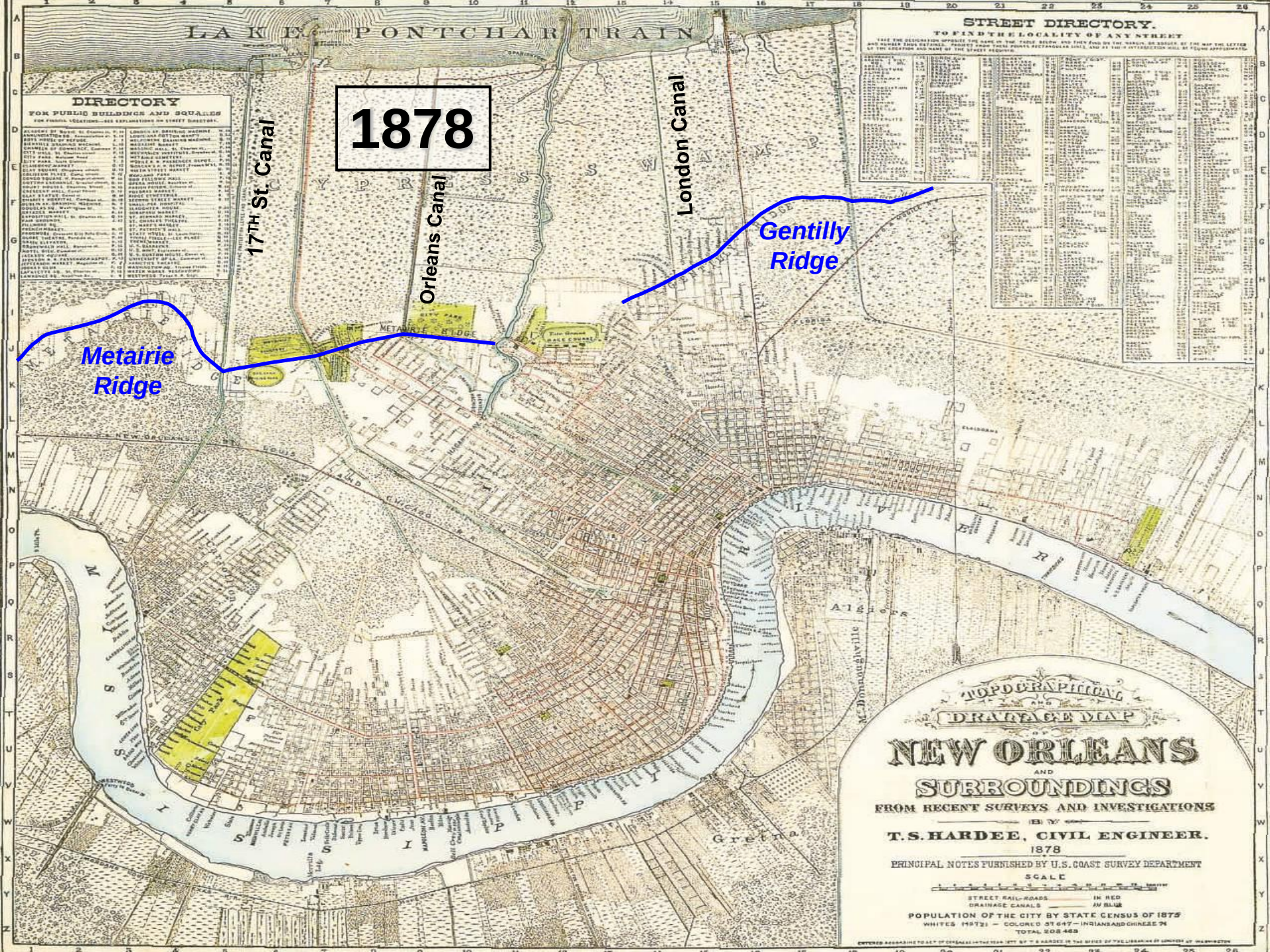
Greater New Orleans Hurricane and Storm Damage Risk Reduction System

Mike Park
Chief
Task Force Hope
U.S. Army Corps of Engineers

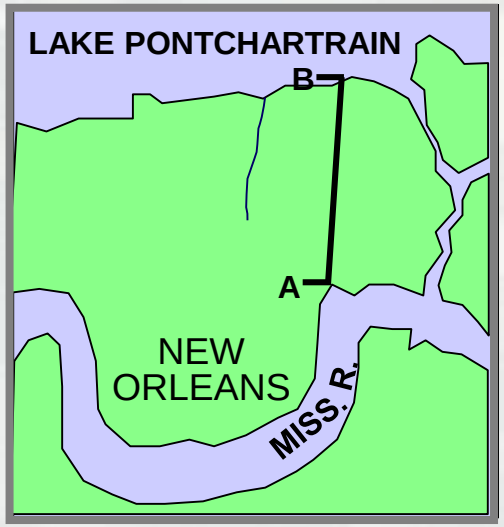
February 24, 2015

US Army Corps of Engineers
BUILDING STRONG®


1878
17TH St. Canal
Orleans Canal
London Canal
Gentilly Ridge
Metairie Ridge
LAKE PONTCHARTRAIN
DIRECTORY
FOR PUBLIC BUILDINGS AND SQUARES
STREET DIRECTORY.
TO FIND THE LOCALITY OF ANY STREET
TOPOGRAPHICAL AND DRAINAGE MAP OF
NEW ORLEANS
AND
SURROUNDINGS
FROM RECENT SURVEYS AND INVESTIGATIONS
BY
T. S. HARDEE, CIVIL ENGINEER.
1878
PRINCIPAL NOTES FURNISHED BY U.S. COAST SURVEY DEPARTMENT
SCALE
STREET RAIL-ROADS IN RED
DRAINAGE CANALS IN BLUE
POPULATION OF THE CITY BY STATE CENSUS OF 1875
WHITES 149731 — COLORED 57 647 — INDIANS AND CHINESE 74
TOTAL 208 452
Algiers
Gretna

New Orleans Topography

City of New Orleans Ground Elevations



From Canal St. at Mississippi River to the Lakefront at U.N.O.

FLOODWALL ALONG MISSISSIPPI RIVER

A

23 FT

MR&T PROJECT DESIGN FLOWLINE (18 FEET)

LONDON AVENUE CANAL FLOODWALL

B

HURRICANE LEVEE / FLOODWALL (14.0 FEET)

ELEVATIONS IN FEET NGVD

30
20
10
0
-10
-20

MISSISSIPPI RIVER BANK
CANAL ST AT RIVER
ST LOUIS CATHEDRAL
ESPLANADE AT ST. CLAUDE
DERBIGNY AT I-10
GENTILLY BLVD AT ALLEN
DILLARD UNIV CAMPUS
ST ANTHONY AT FILMORE AVE
WAINRIGHT DR AT L. C. SIMON
UNO SIDE OF WAINWRIGHT DR
LAKE PONTCHARTRAIN SHORE

Hurricane Katrina

Aug 29, 2005

- One of America's largest natural disasters
- Cat 5 less than 12 hrs before landfall
- 127 MPH wind at Louisiana landfall
- Maximum surge of 28 to 30 feet along Mississippi coast
- 80 percent of the city of New Orleans flooded

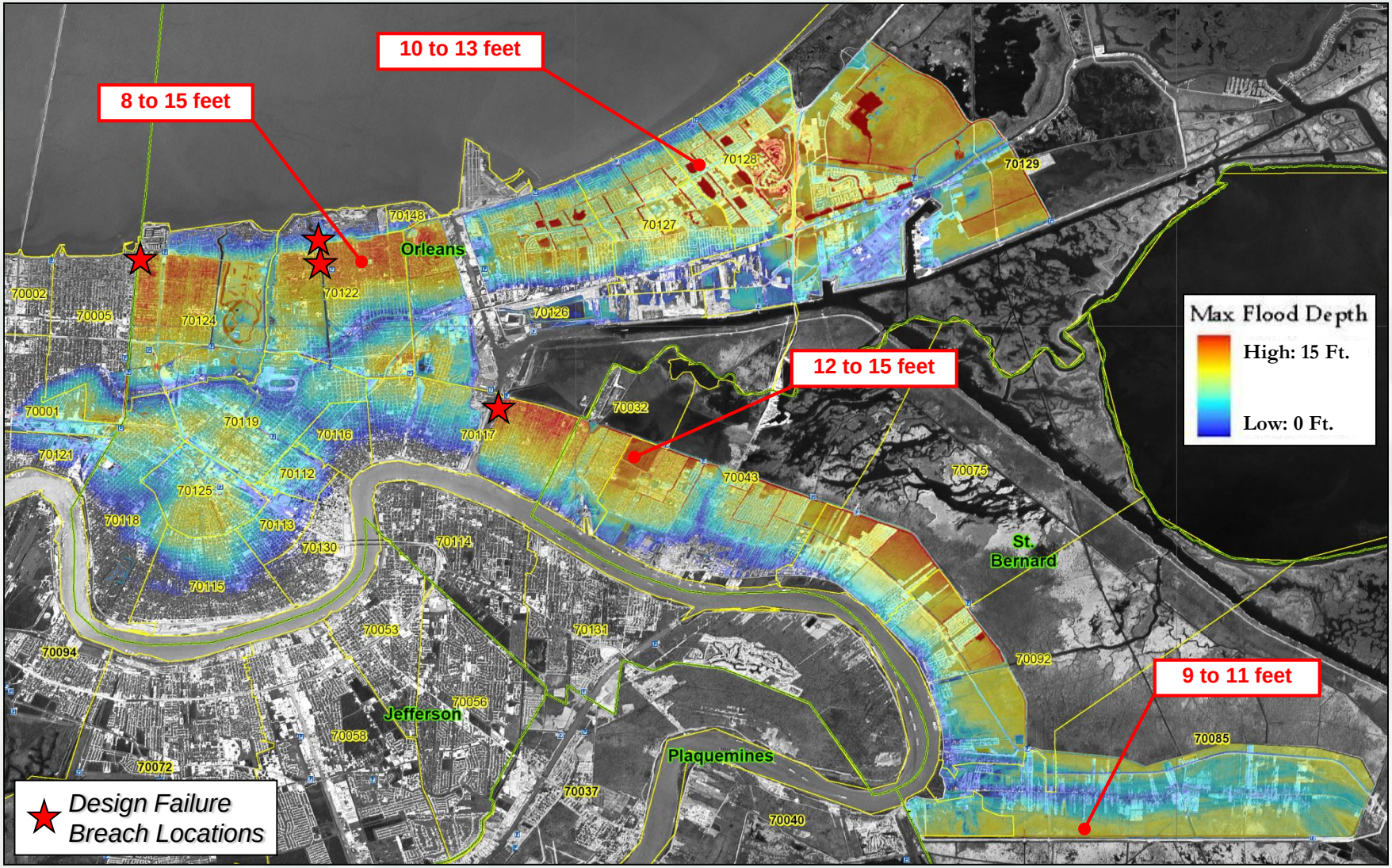
Hurricane Rita

Sep 24, 2005

- Cat 4 less than 12 hrs before landfall
- 175 MPH max sustained winds in Gulf of Mexico
- 120 MPH max sustained winds at landfall
- Cat 3 strength at landfall

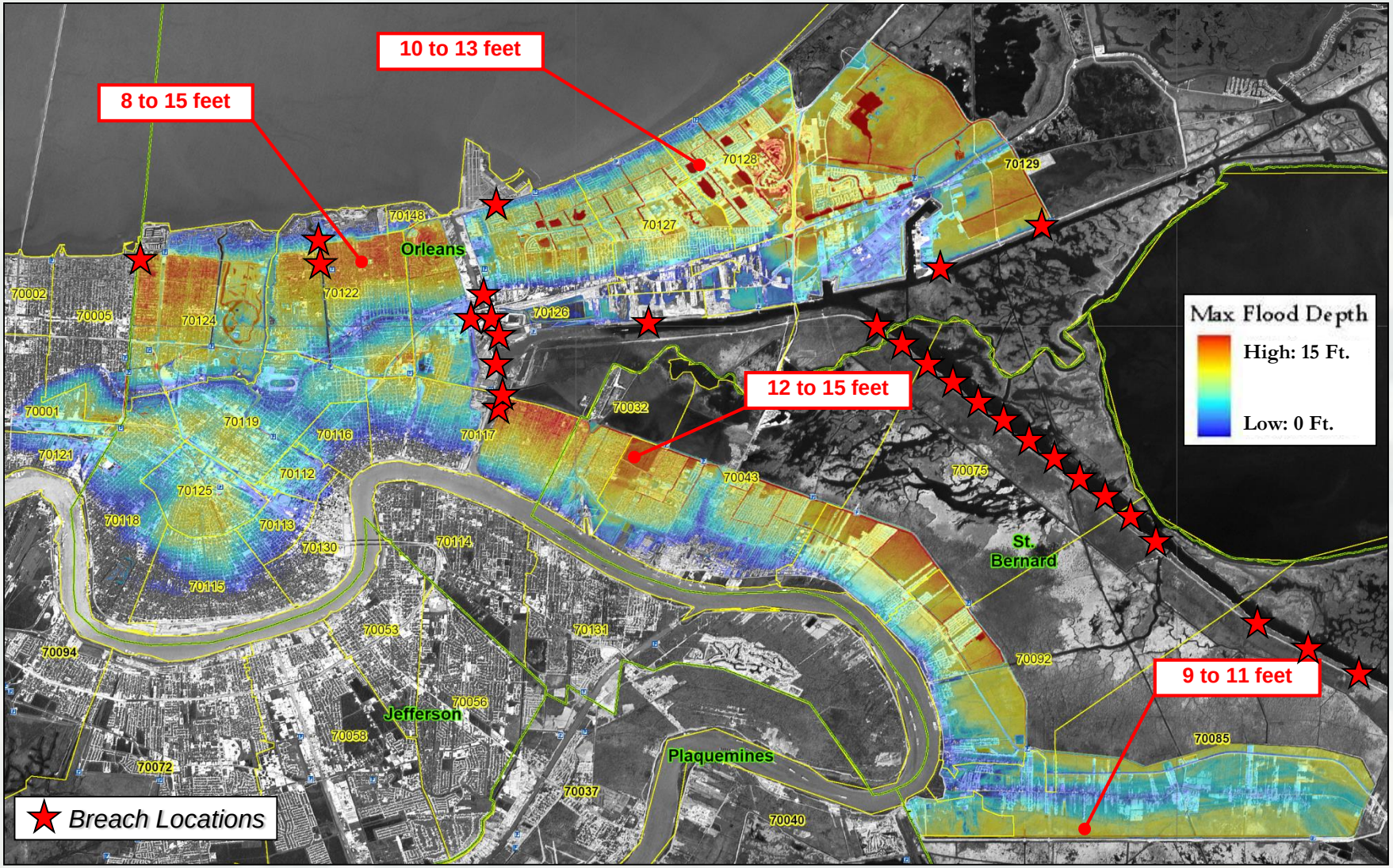
New Orleans

Maximum Flooding Depth



New Orleans

Levee and Floodwall Breaches



Effects of Hurricane Katrina

Transition Erosion

Levee Erosion

Katrina Floodwall Breaches

Wave Overtopping Effects

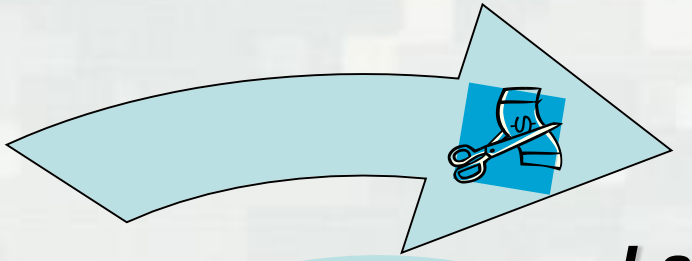
IPET – Interagency Performance Evaluation Task Force

- Over 150 members: academia, industry, state and federal agencies
- Charged to answer 5 Questions:
  - Flood Protection System
  - Storm
  - Performance
  - Consequences
  - Risk
- Peer review by National Academy of Sciences and ASCE
- Draft report June 2006
- Final report released spring 2009

Hurricane Protection Decision Chronology

Key Decision Influences

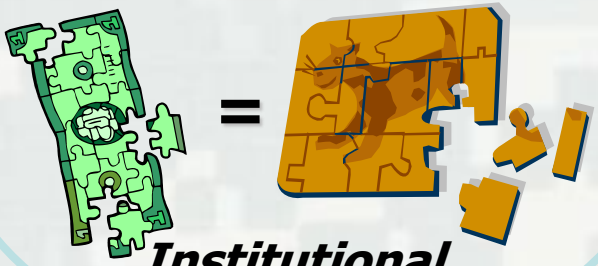
Tyranny of Incremental Decisions



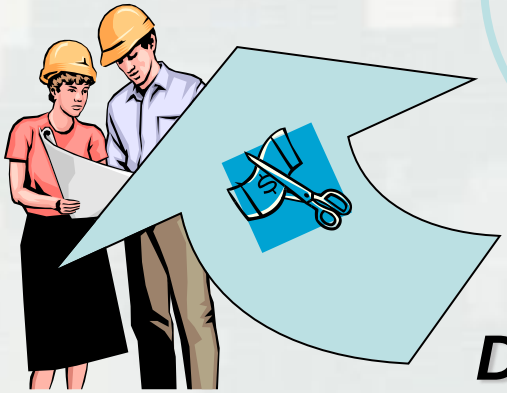
Loss of Vision for an Integrated System

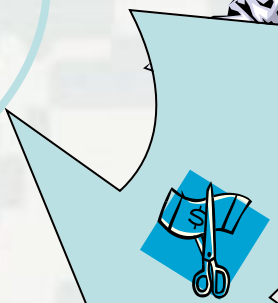
Lack of Dynamic Use of New Information

Shared Sensitivity to Cost Concerns



Institutional Response

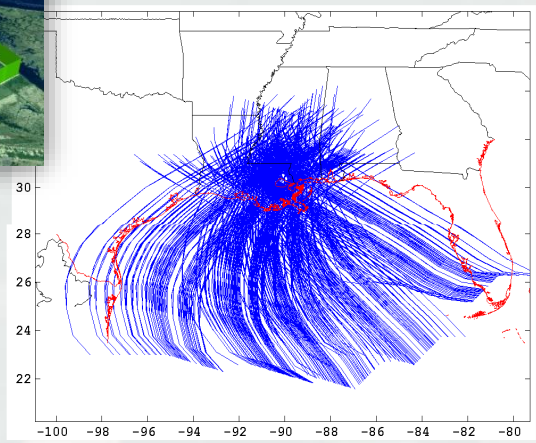


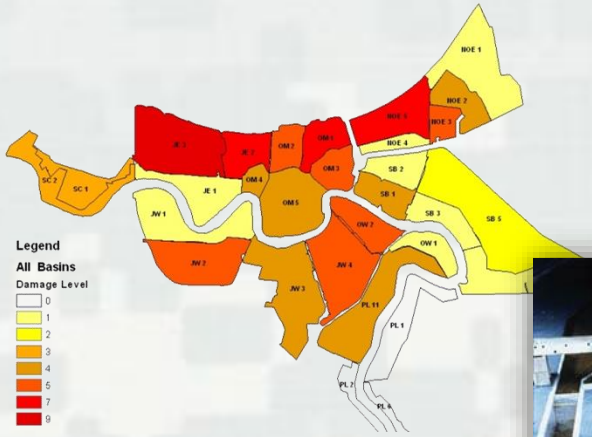


Organizational Decision-Making Issues

USACE's Actions for Change

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





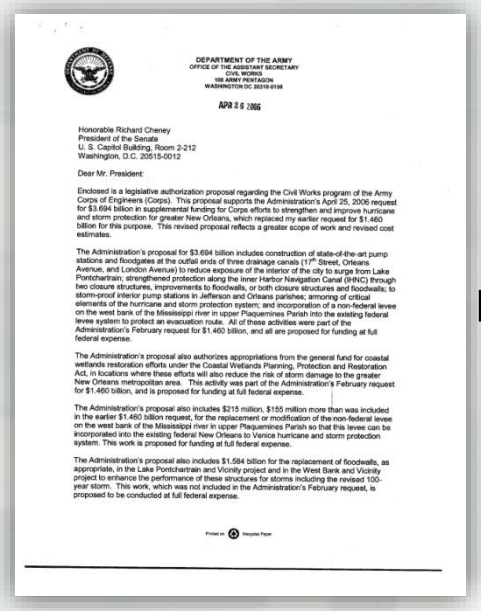
HSDRRS:
Our Mission and Commitment

- *Repair the damages, making what was there before whole again.*

- *By 1 June 2011, strengthen and improve the system and provide 100-year level of risk reduction capable of withstanding the effects of a storm having a 1% chance of occurring each year.*

- *Current funding level $14.48 B (fully funded).*

HSDRRS Authorization



DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
CIVIL WORKS
108 ARMY PENTAGON
WASHINGTON DC 20310-0108

APR 26 2006

Honorable Richard Cheney
President of the Senate
U. S. Capitol Building, Room 2-212
Washington, D.C. 20515-0012

Dear Mr. President:

Enclosed is a legislative authorization proposal regarding the Civil Works program of the Army Corps of Engineers (Corps). This proposal supports the Administration's April 25, 2006 request for $3.694 billion in supplemental funding for Corps efforts to strengthen and improve hurricane and storm protection for greater New Orleans, which replaced my earlier request for $1.460 billion for this purpose. This revised proposal reflects a greater scope of work and revised cost estimates.

The Administration's proposal for $3.694 billion includes construction of state-of-the-art pump stations and floodgates at the outfall ends of three drainage canals (17th Street, Orleans Avenue, and London Avenue) to reduce exposure of the interior of the city to surge from Lake Pontchartrain; strengthened protection along the Inner Harbor Navigation Canal (IHNC) through two closure structures, improvements to floodwalls, or both closure structures and floodwalls; to storm-proof interior pump stations in Jefferson and Orleans parishes; armoring of critical elements of the hurricane and storm protection system; and incorporation of a non-federal levee on the west bank of the Mississippi river in upper Plaquemines Parish into the existing federal levee system to protect an evacuation route. All of these activities were part of the Administration's February request for $1.460 billion, and all are proposed for funding at full federal expense.

The Administration's proposal also authorizes appropriations from the general fund for coastal wetlands restoration efforts under the Coastal Wetlands Planning, Protection and Restoration Act, in locations where these efforts will also reduce the risk of storm damage to the greater New Orleans metropolitan area. This activity was part of the Administration's February request for $1.460 billion, and is proposed for funding at full federal expense.

The Administration's proposal also includes $215 million, $155 million more than was included in the earlier $1.460 billion request, for the replacement or modification of the non-federal levee on the west bank of the Mississippi river in upper Plaquemines Parish so that this levee can be incorporated into the existing federal New Orleans to Venice hurricane and storm protection system. This work is proposed for funding at full federal expense.

The Administration's proposal also includes $1.584 billion for the replacement of floodwalls, as appropriate, in the Lake Pontchartrain and Vicinity project and in the West Bank and Vicinity project to enhance the performance of these structures for storms including the revised 100-year storm. This work, which was not included in the Administration's February request, is proposed to be conducted at full federal expense.

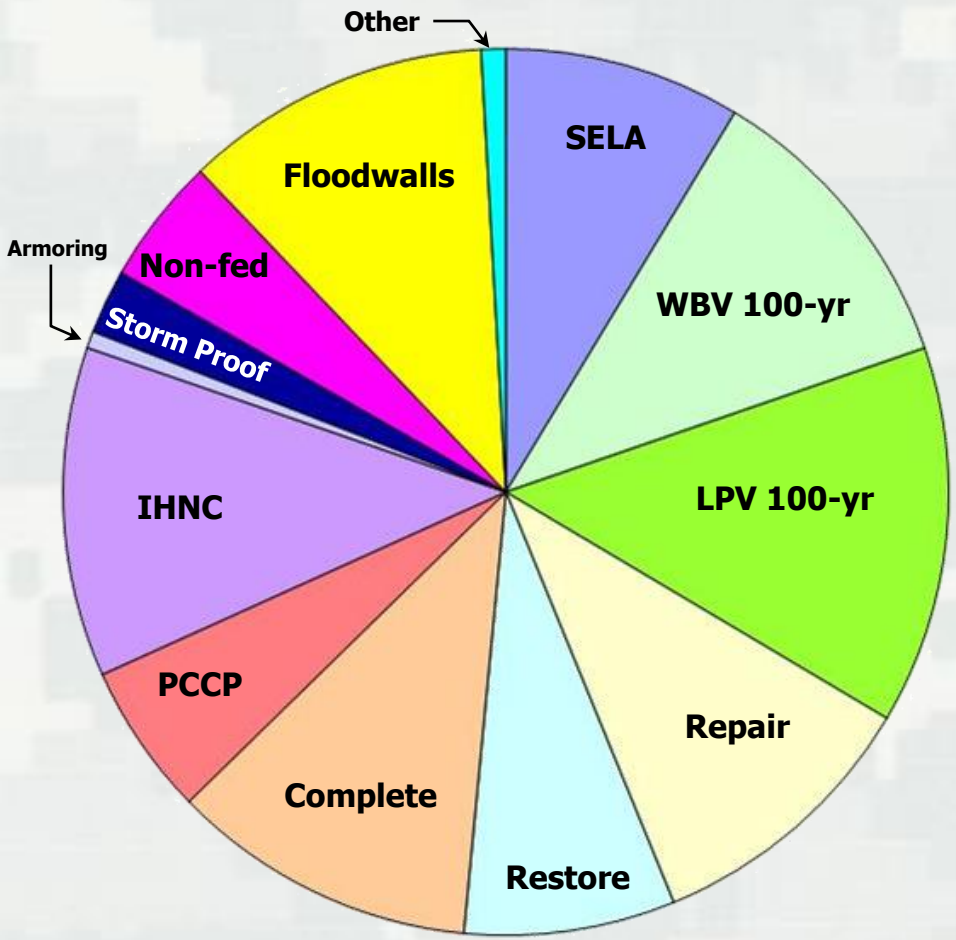
Printed on Recycled Paper

4th Emergency Supplemental (June 2006)

…authorized to raise, as appropriate, levee heights and otherwise enhance the existing Lake Pontchartrain and Vicinity project and the existing West Bank and Vicinity project to provide the levels of protection necessary to achieve **certification required for participation in the National Flood Insurance Program**…

HSDRRS Funding Breakdown

TOTAL APPROPRIATED FUNDS: $14.48 B



COMPONENT	$ (M)
SELA (Interior Drainage)	*$1,155*
WBV 100-year Level of Protection	*$2,010*
LPV 100-year Level of Protection	*$1,690*
Repair Existing System	*$1,483*
Restore to Design Height	*$1,010*
Complete Authorized System	*$1,643*
Permanent Pump Stations	*$854*
IHNC	*$1,603*
Selective Armoring	*$414*
Storm-proof Existing Pump Stations	*$340*
Incorporate non-Fed Levees in Plaquemines Parish	*$671*
Reinforce or Replace Floodwalls	*$1,481*
Other	*$110*

NEPA Alternative Arrangements

- **Alternative Arrangements Approved by CEQ** – to facilitate expedited construction of the 100-year level HSDRRS to abate extreme risk to life and property

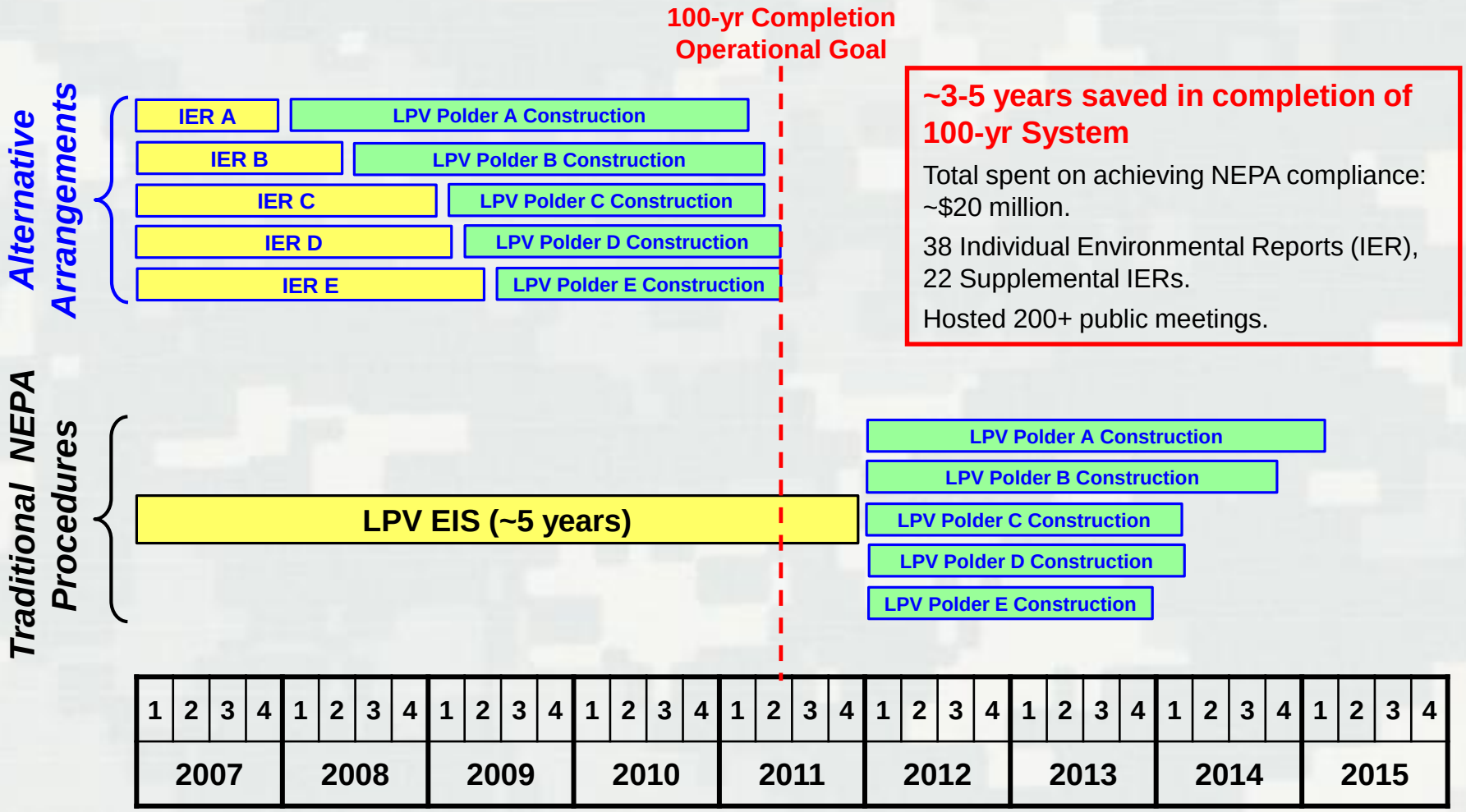
- **NEPA Environmental Review** – achieved through concurrent development of multiple Individual Environmental Reports (IERs) for segments of the system in lieu of comprehensive Environmental Impact Statement (EIS)

- **Consolidated Environmental Document –** compilation of IERs into a single document assessing cumulative environmental impacts of HSDRRS

NEPA Compliance Schedule Impact

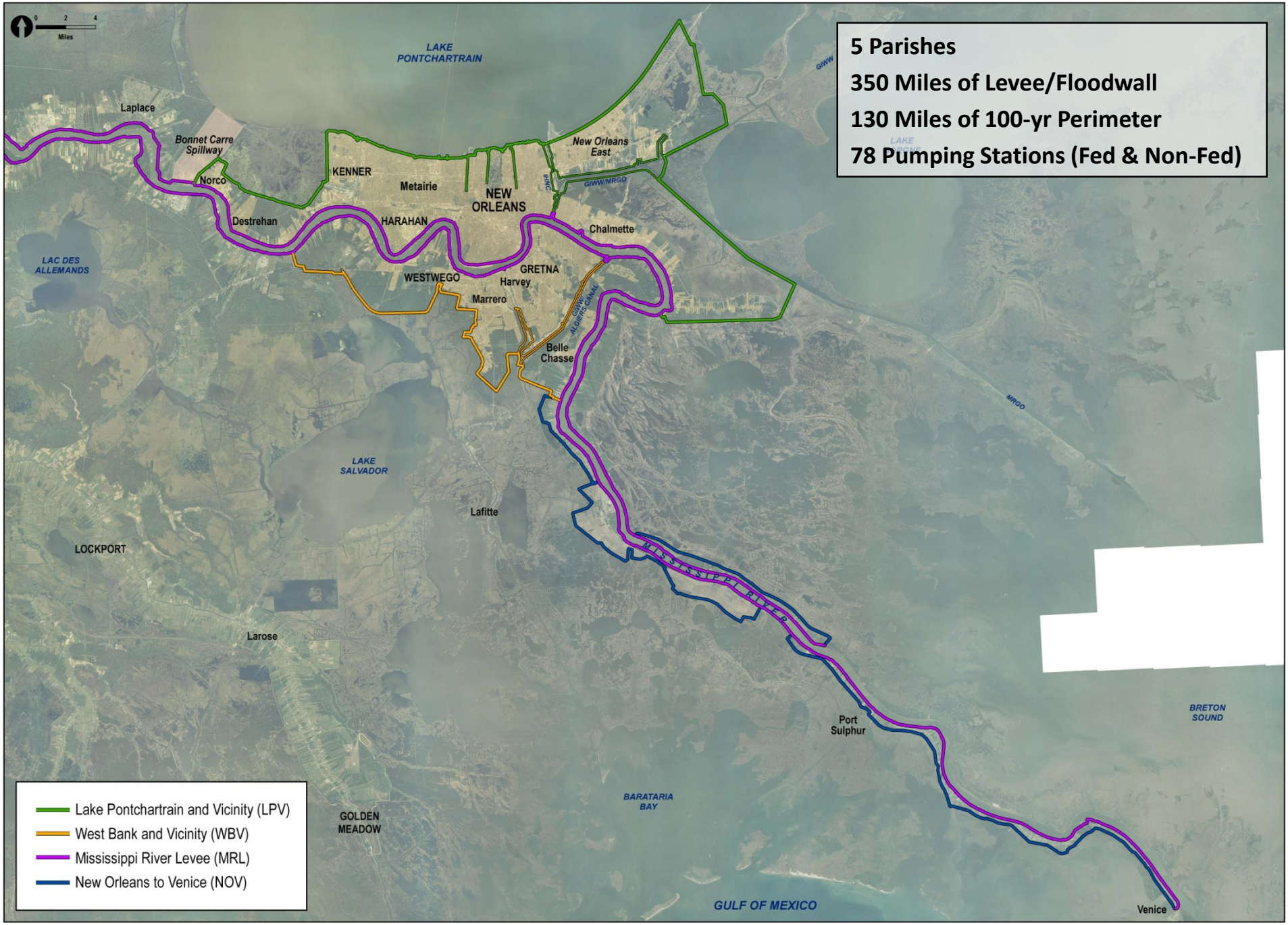
NOTIONAL

Estimated NEPA Compliance and Construction Times



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)



Deliver the Greater New Orleans HSDRRS Mission

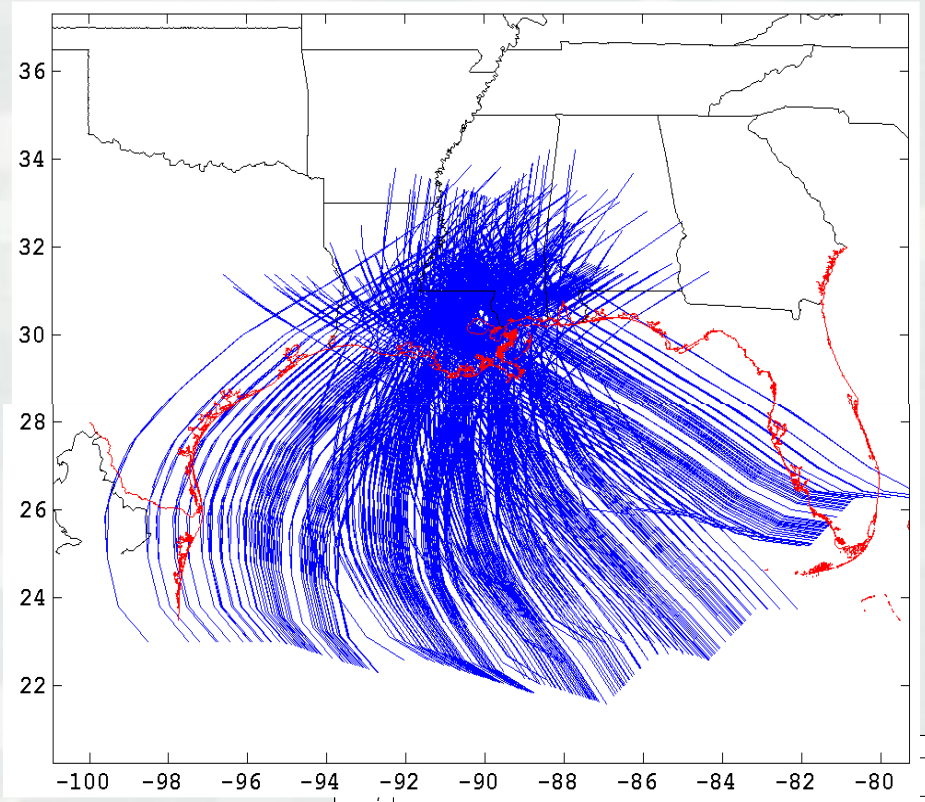
Challenges

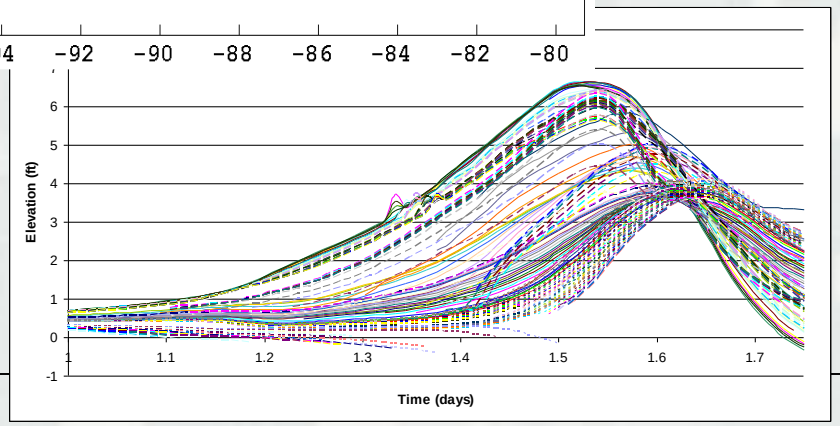
- Mandate to deliver $14.6B construction program within budget and on schedule
- Form design criteria, program cost estimate, acquire funding
- Intense scrutiny / oversight
- New governances
- **NEPA compliance**
- Deliver a comprehensive system

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

Hurricane Paths Considered in the Risk Analysis





- *3 HSDRRS Geometries*
  - *Pre-Katrina*
  - *Current (1 June 07)*
  - *100-year LOP (~2011)*
- *152 storms*
  - *25 yr to 5,000+ yr*
- *350+ features*
  - *Floodwalls*
  - *Levees*
  - *Pumps Stations*

→ **62,928 Hurricane Hydrographs**

HSDRRS 100YR Design Elevation Criteria

- Elevation set to higher of:
  - That required to limit wave overtopping associated with a 100-yr storm surge to 0.01 cfs/ft with 50% confidence of non-exceedance

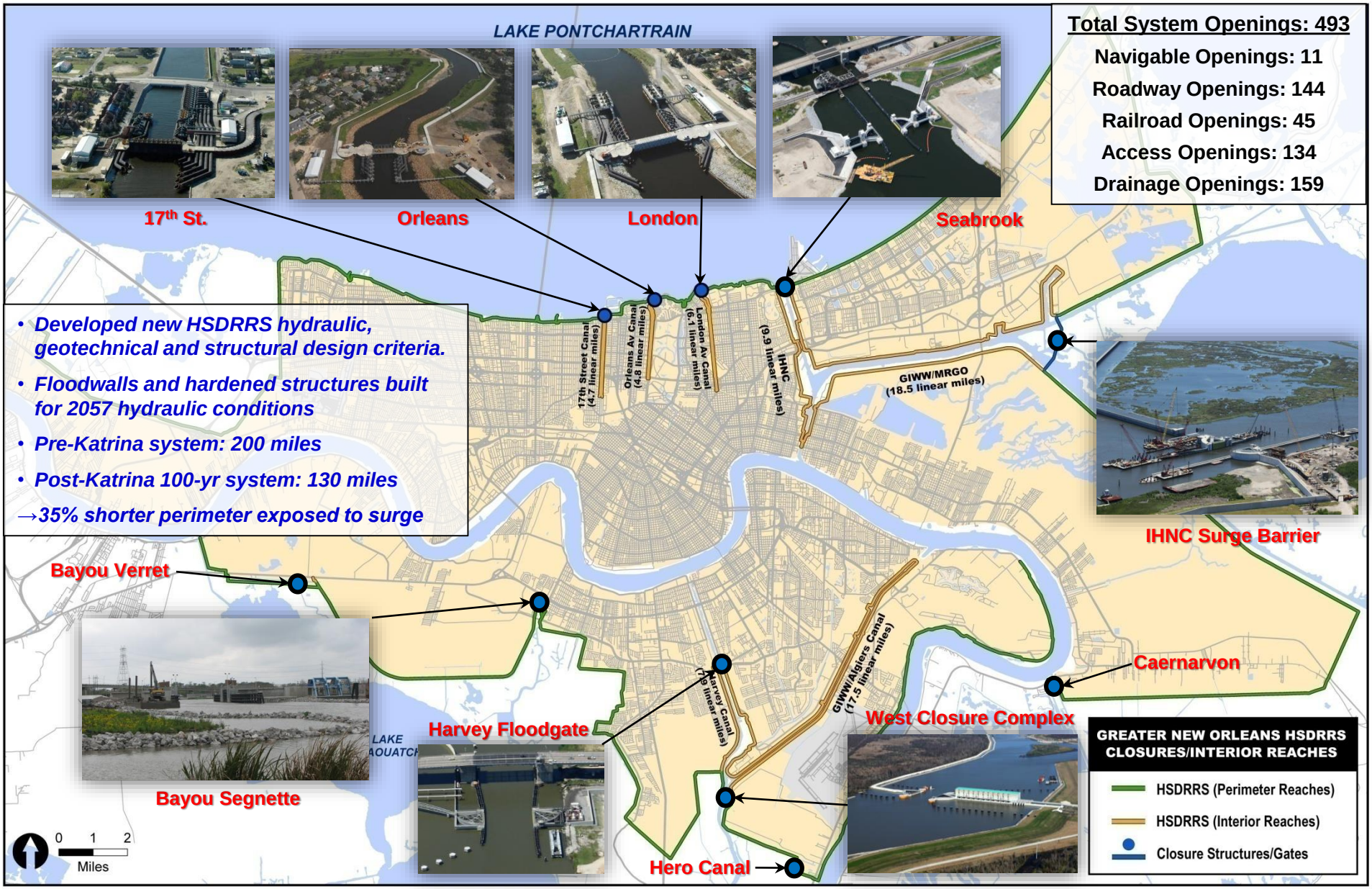
  Or

  - That required to limit wave overtopping associated with a 100-yr storm surge to 0.1 cfs/ft at 90% confidence of non-exceedance

  Or

  - The 500-yr still water elevation with a 50% confidence of non-exceedance

A Stronger System Than Ever Before

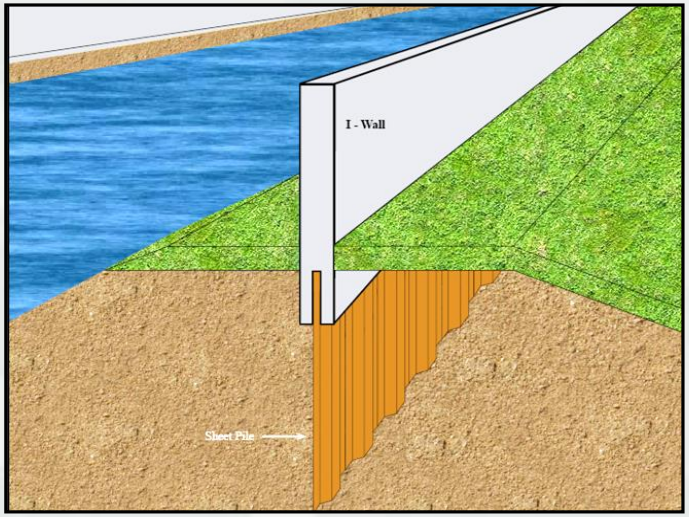


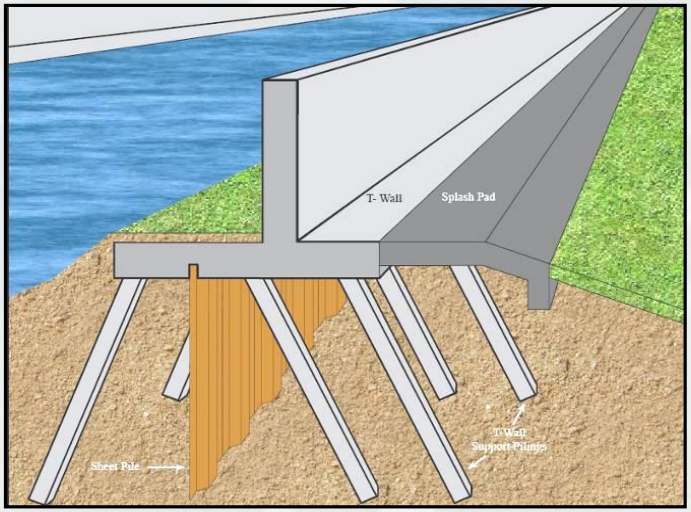
New Orleans East

Surge Barrier Tie-In

Design Improvements

T/I wall design

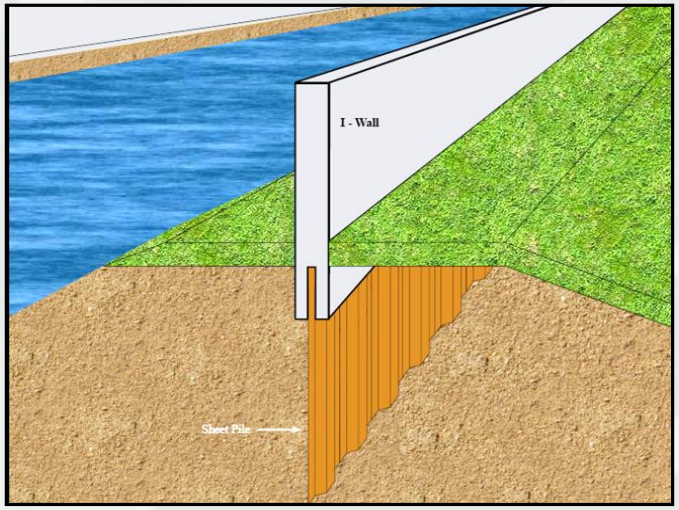


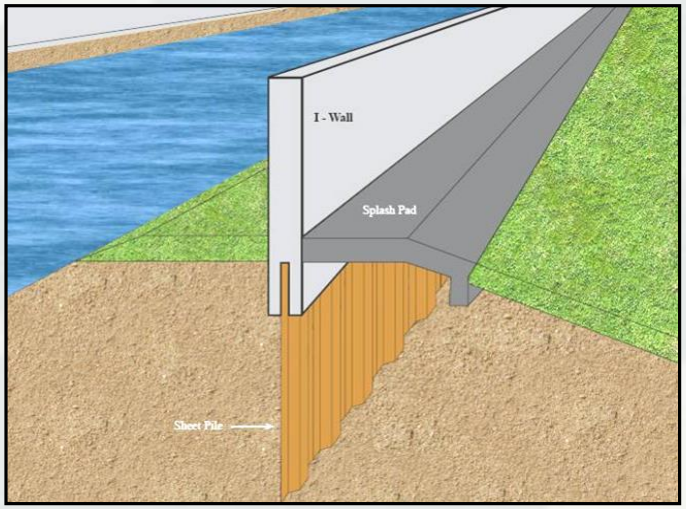


Before

After

Scour protection





Interim Closure Structures

Orleans Ave. Canal

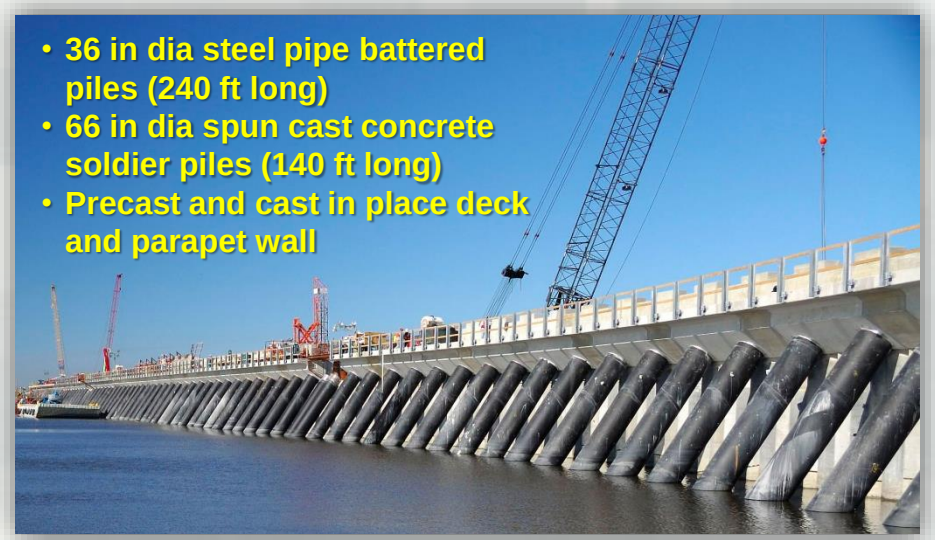
London Ave. Canal

17th St. Canal

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

Permanent Canals Closures and Pumps

IHNC Lake Borgne Surge Barrier



Seabrook Gate Complex

Pump Station Fronting Protection

Bayou Segnette Pump Station

Completed Safe House

West Closure Complex

West Closure Complex

Pump Station

5400 hp diesel engines drive 11 flowerpot pumps

New Orleans East 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
- ECI

New Orleans East Levee

- *2 ft. thick sand blanket with 9 in. layer of gravel on top*
- *1,000,000 total cubic yards of sand*

Bayou Sauvage
National Wildlife
Refuge

Old
Levee

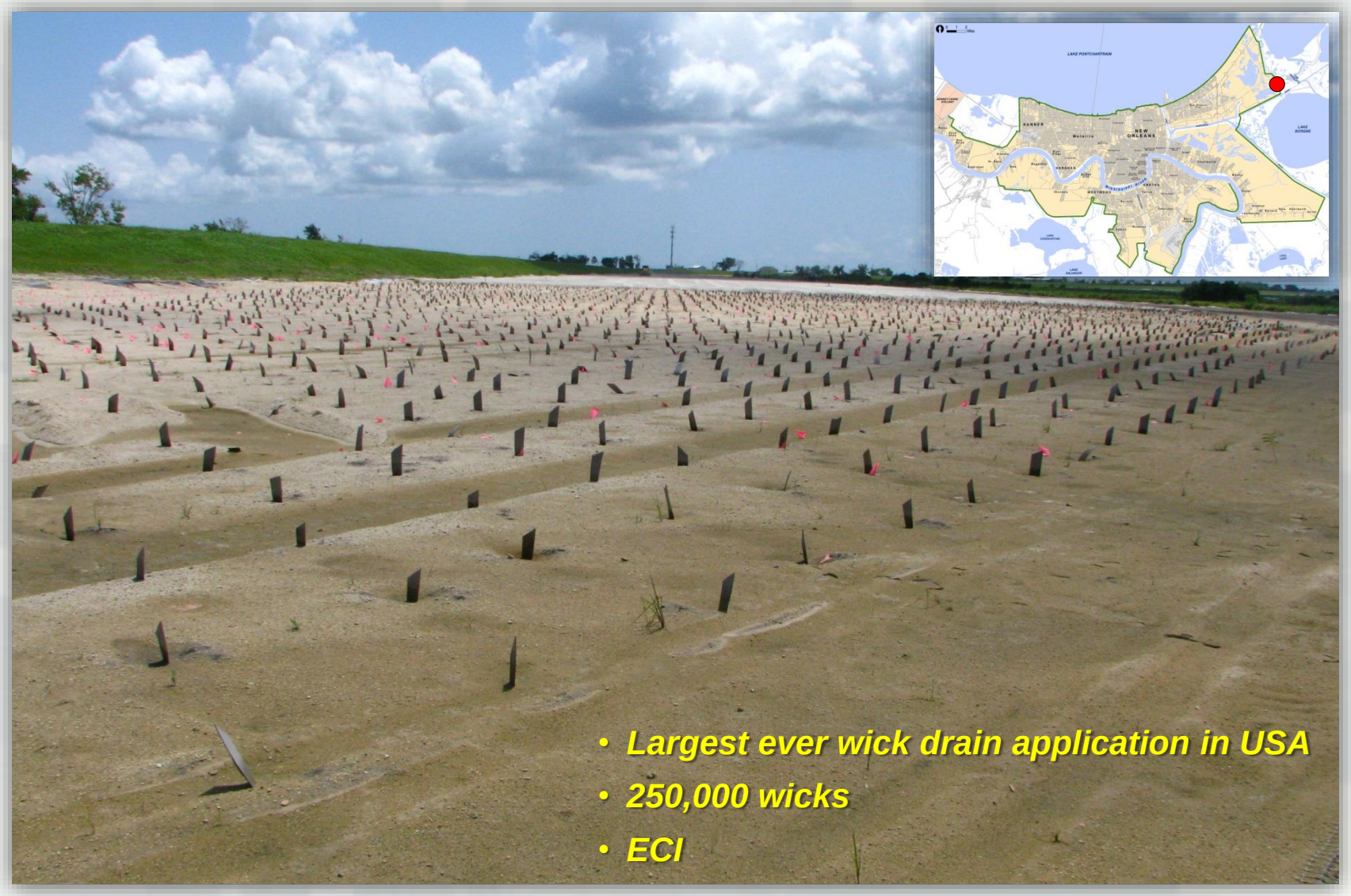
New Levee

~1 Football Field

Over 1 Superdome of Clay

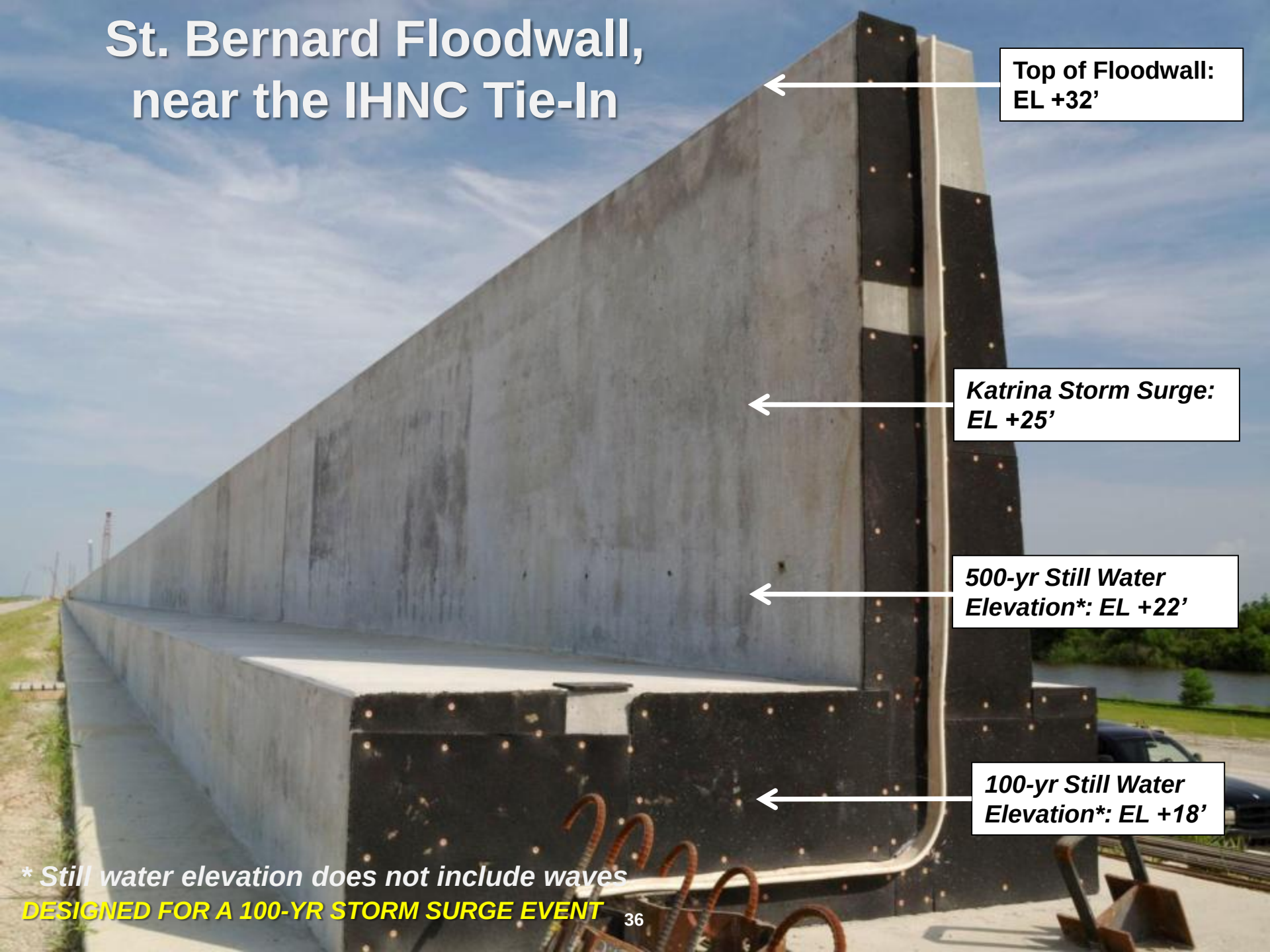
(4.9 mil cy) Required

Wick Drains



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

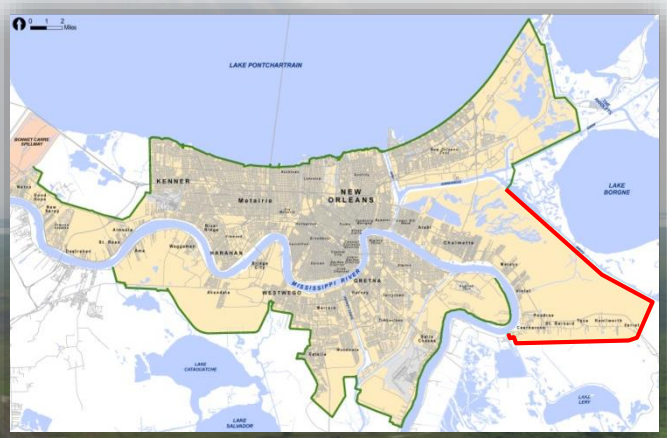
St. Bernard Floodwall, near the IHNC Tie-In



** Still water elevation does not include waves*

DESIGNED FOR A 100-YR STORM SURGE EVENT

St. Bernard Floodwall



- 3 contracts
- ~$1 B
- 23 miles (2 mi completed per month at peak of construction)
- ECI

St. Bernard Floodwall Construction – Southern Reach

HSDRRS Remaining Work

SELA Interior Drainage

Permanent Pump Stations

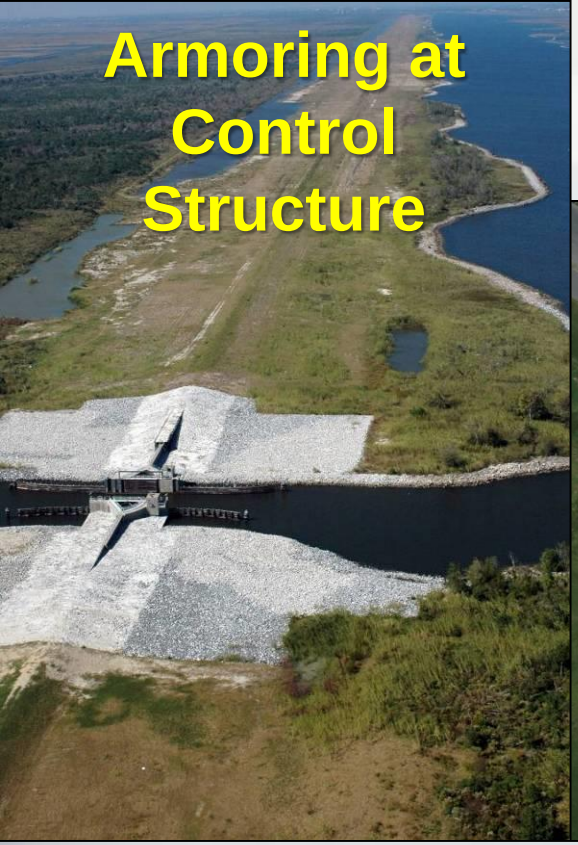
Mississippi River / HSDRRS Co-located Levees

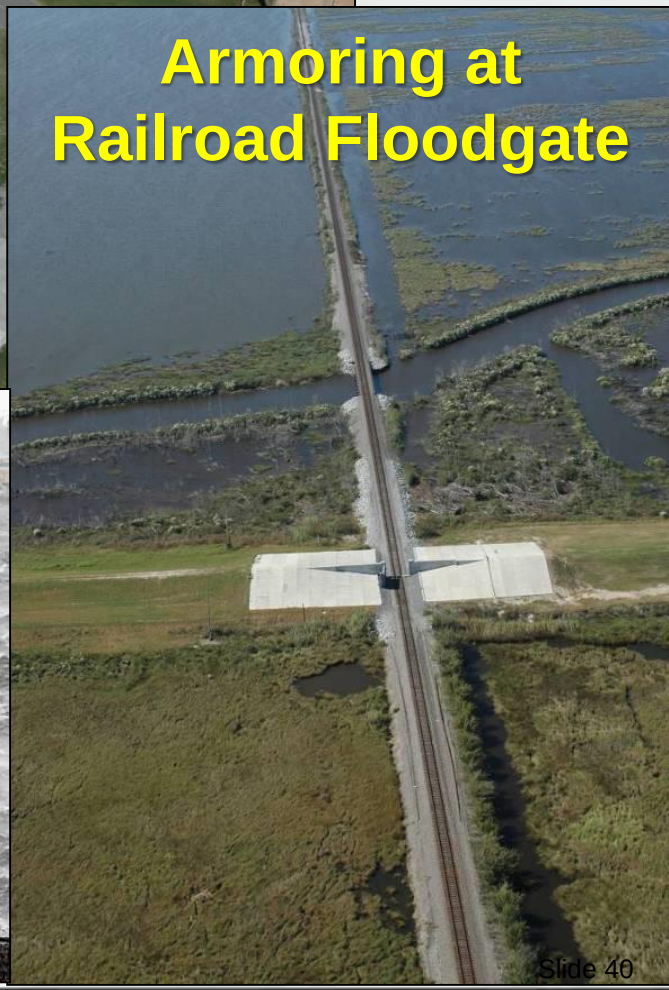
Armoring

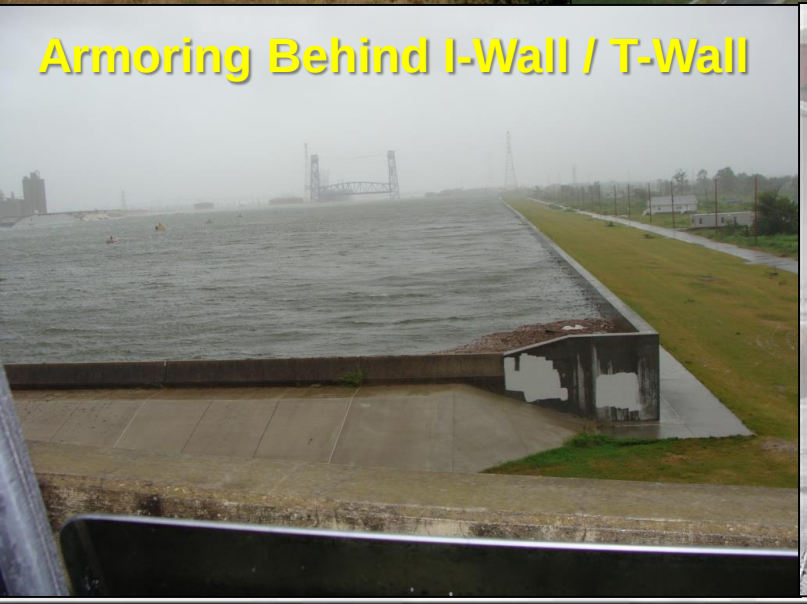
Environmental Mitigation

New Orleans to Venice / Non-Federal Levees

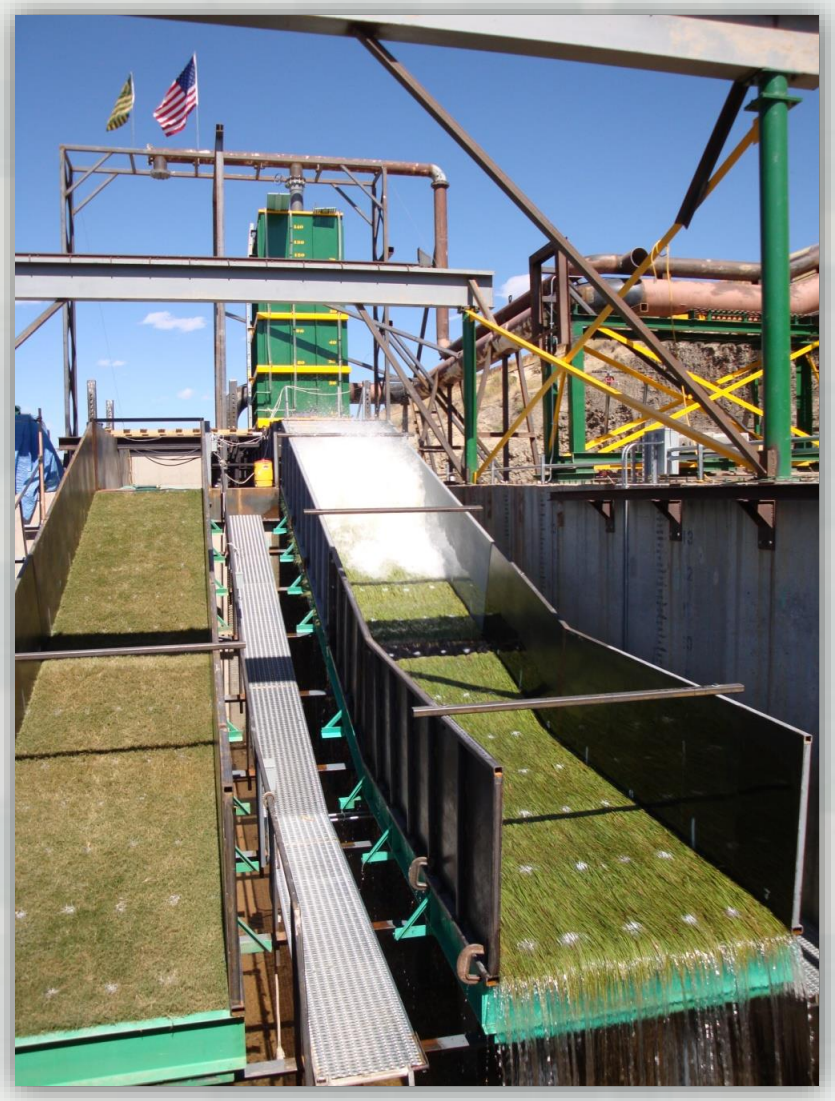
Transition Armoring







Armoring



Wave Overtopping Testing

Turf Reinforcement Mat

Sod / Enhanced Grass

HSDRRS Environmental Mitigation

Impacts (2,295 acres)

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

Current Plan

- 3 Mitigation Bank projects
- 10 Corps constructed projects

Project Construction Value: $190 M

Bottomland Hardwoods Wet

Challenges

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

Swamp

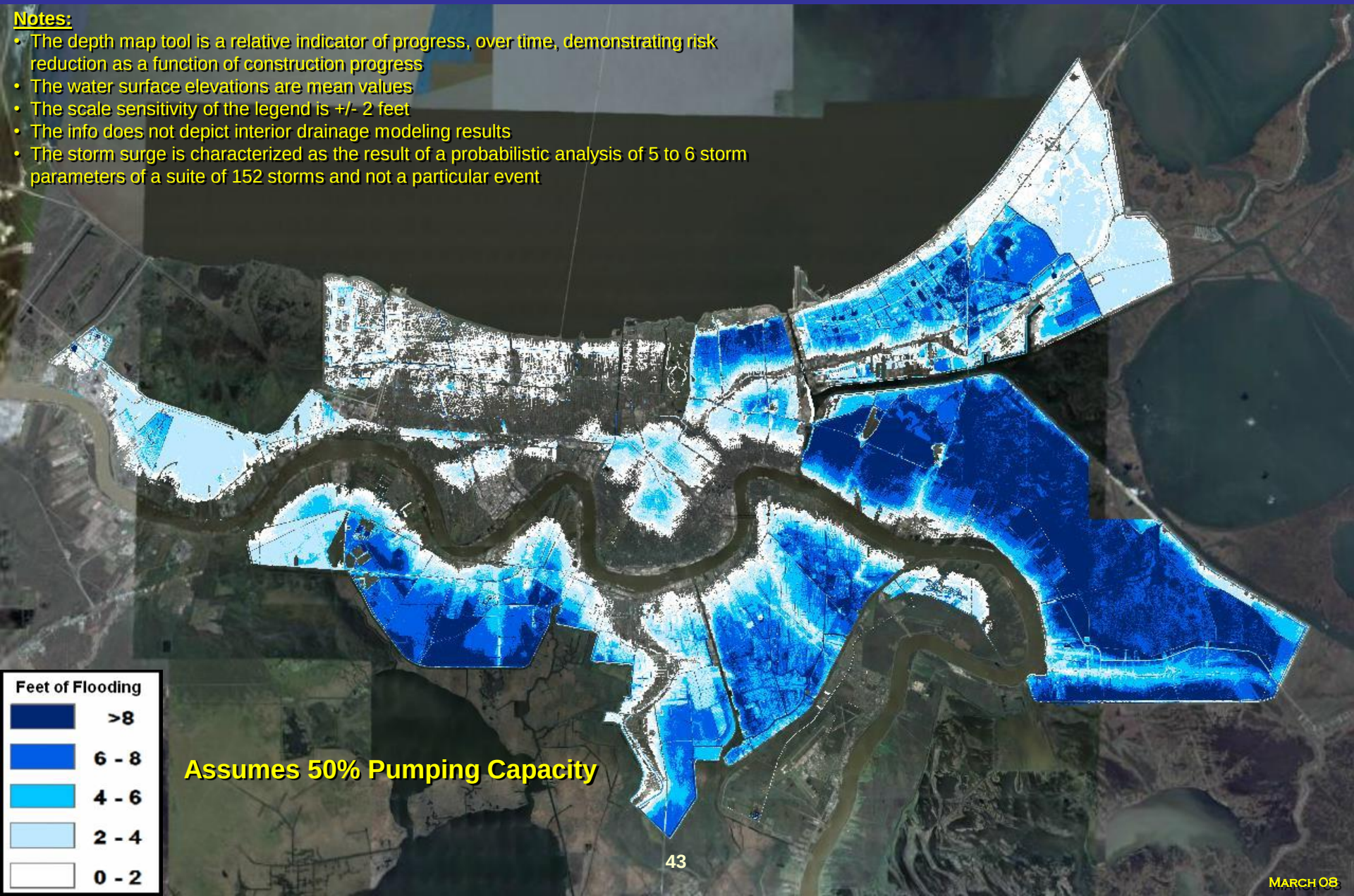
Marsh

Bottomland Hardwoods Dry

In 2007, you had a 1% chance every year of flooding this deep from Hurricanes

Notes:

- The depth map tool is a relative indicator of progress, over time, demonstrating risk reduction as a function of construction progress
- The water surface elevations are mean values
- The scale sensitivity of the legend is +/- 2 feet
- The info does not depict interior drainage modeling results
- The storm surge is characterized as the result of a probabilistic analysis of 5 to 6 storm parameters of a suite of 152 storms and not a particular event



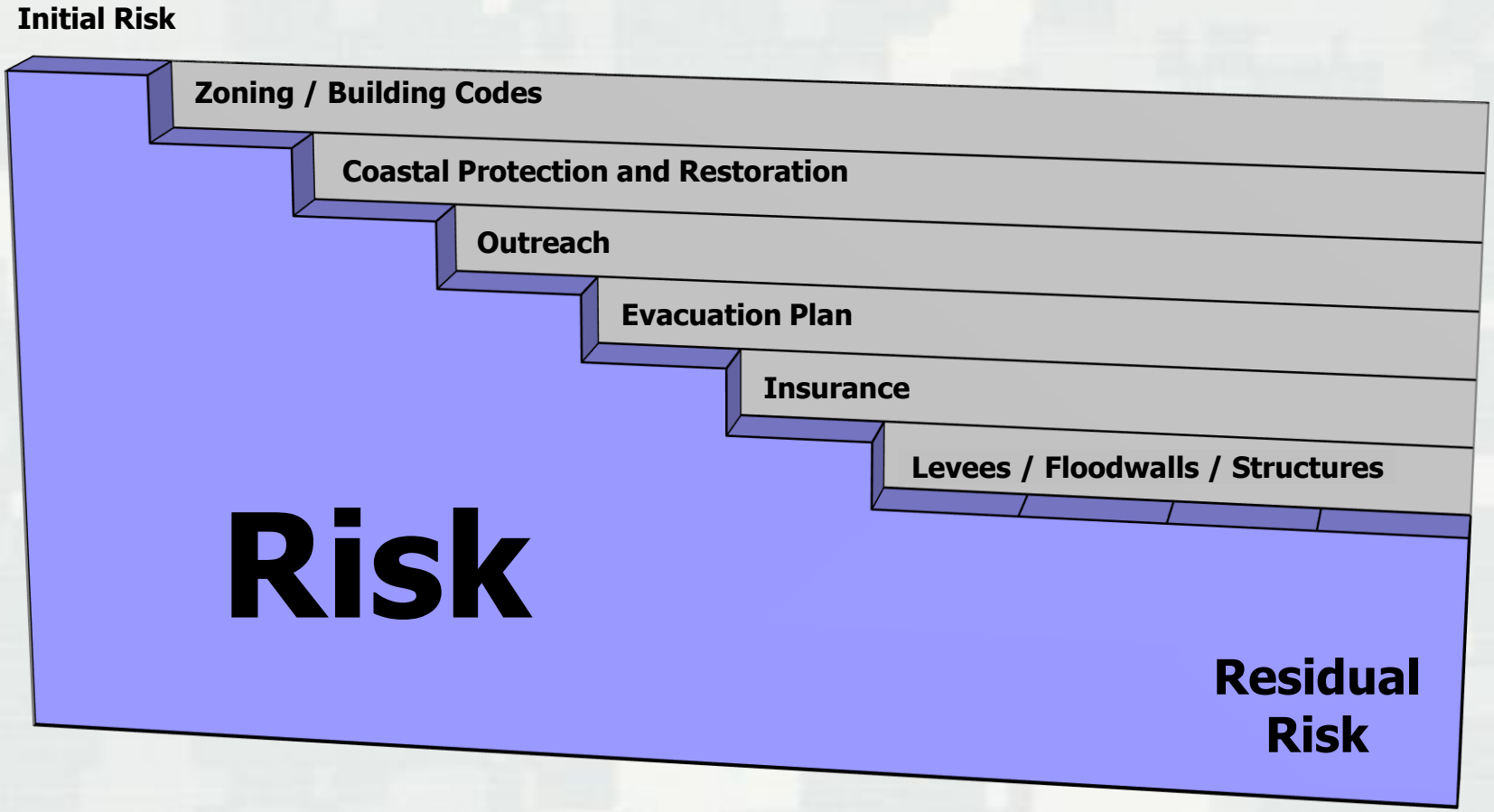
With the 100-year level of protection, you have a 1% chance every year of flooding this deep from Hurricanes

Notes:

- The depth map tool is a relative indicator of progress, over time, demonstrating risk reduction as a function of construction progress
- The water surface elevations are mean values
- The scale sensitivity of the legend is +/- 2 feet
- The info does not depict interior drainage modeling results
- The storm surge is characterized as the result of a probabilistic analysis of 5 to 6 storm parameters of a suite of 152 storms and not a particular event

With the 100-year level of protection, you have a 0.2% chance every year of flooding this deep from Hurricanes

Buying Down Risk



Discussion / Questions