Conceptual Approaches to Water and Environmental Management

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Thanks to Dom Izzo, RAND RGSPI , PWA, Si Simer

Outline

- Where do we want to go?
  - Fuzzy picture, clear objectives
- How are we going to proceed?
  - Principles
- Managing coastal systems
  - Guiding vs. manipulating
- Expectations
  - Change happens

Where do we want to go?

- Water supply reliability
- Water quality
- Species recovery
- Ecosystem sustainability
- Public safety
- Economic well being

Master Plan Purpose

- In order to provide for the well-being of the people of Louisiana and thus the Nation, the State of Louisiana must formulate and implement a strategy for *long-term comprehensive coastal protection* including policies, plans and programs that integrate *a sustainable solution to hurricane protection and coastal restoration*.

- In order to achieve comprehensive coastal protection, the plan must *accommodate multiple uses of the coastal zone* and achieve a proper *balance between development and conservation, restoration, creation, and nourishment of renewable coastal resources*.

Coastwide Planning Objectives

1. Reduce economic losses from storm based flooding to residential, public, industrial, and commercial infrastructure, providing a level of protection commensurate with the assets at risk, with a minimum level of protection equivalent to a storm surge with 1% annual chance of recurrence.

2. Promote a sustainable ecosystem by harnessing the processes of the natural system

3. Provide habitats suitable to support an array of commercial and recreational activities coast-wide.

4. Sustain, to the extent practicable, the unique heritage of coastal Louisiana by protecting traditional living cultures including their historic properties and their ties and relationship to the natural environment

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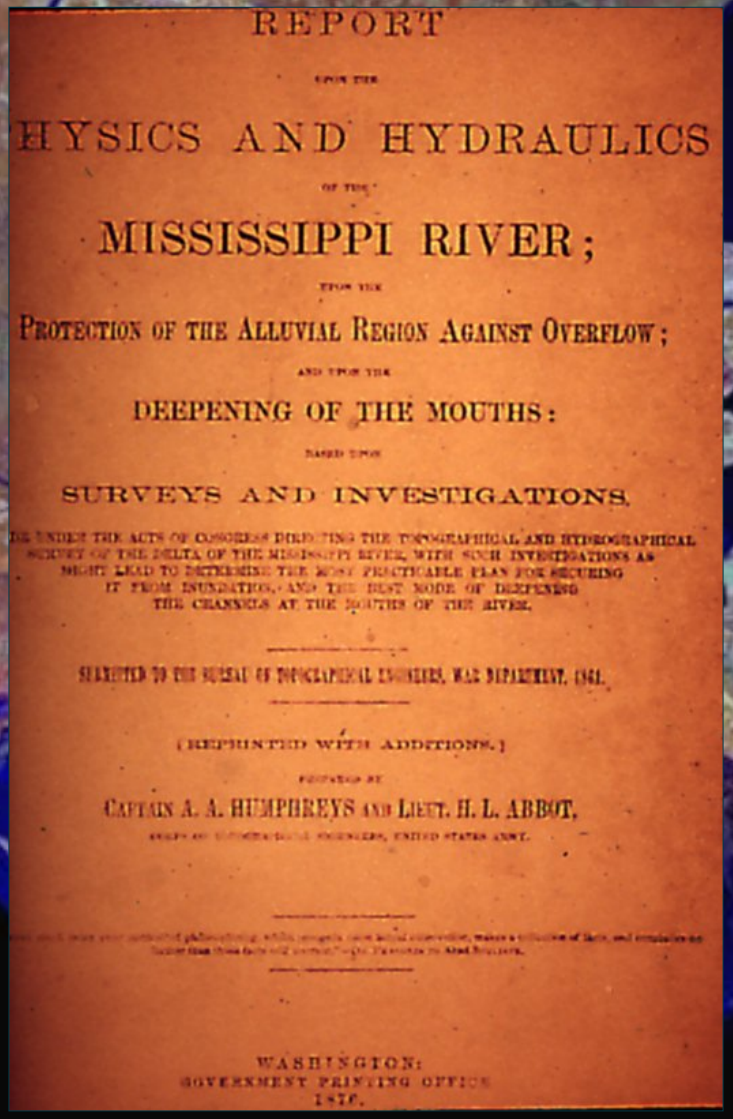
Vision ≠ Objectives

- Water supply reliability
  - Enough to do what?
- Water quality
  - To support which use?
- Species recovery
  - Which, where?
- Ecosystem sustainability
  - Desirable characteristics?
- Public safety
  - Define hazard?
- Economic well being……..

How to get there?

- By any means possible?
- Current vs. future context
- System level impacts

Early River Management



REPORT

HYSICS AND HYDRAULICS

MISSISSIPPI RIVER;

PROTECTION OF THE ALLUVIAL REGION AGAINST OVERFLOW;

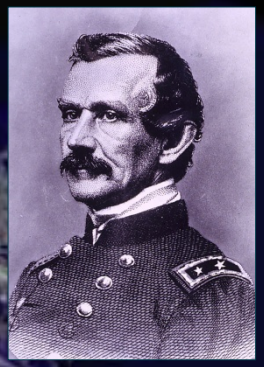
DEEPENING OF THE MOUTHS:

SURVEYS AND INVESTIGATIONS.

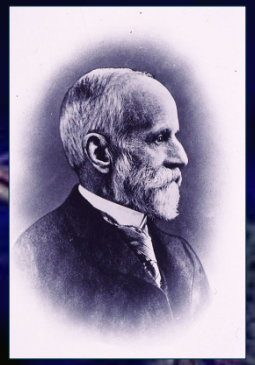
[REPRINTED WITH ADDITIONS.]

CAPTAIN A. A. HUMPHREYS AND LIEUT. H. L. ABBOT,

WASHINGTON:
GOVERNMENT PRINTING OFFICE
1876.



Captain A. A. Humphreys



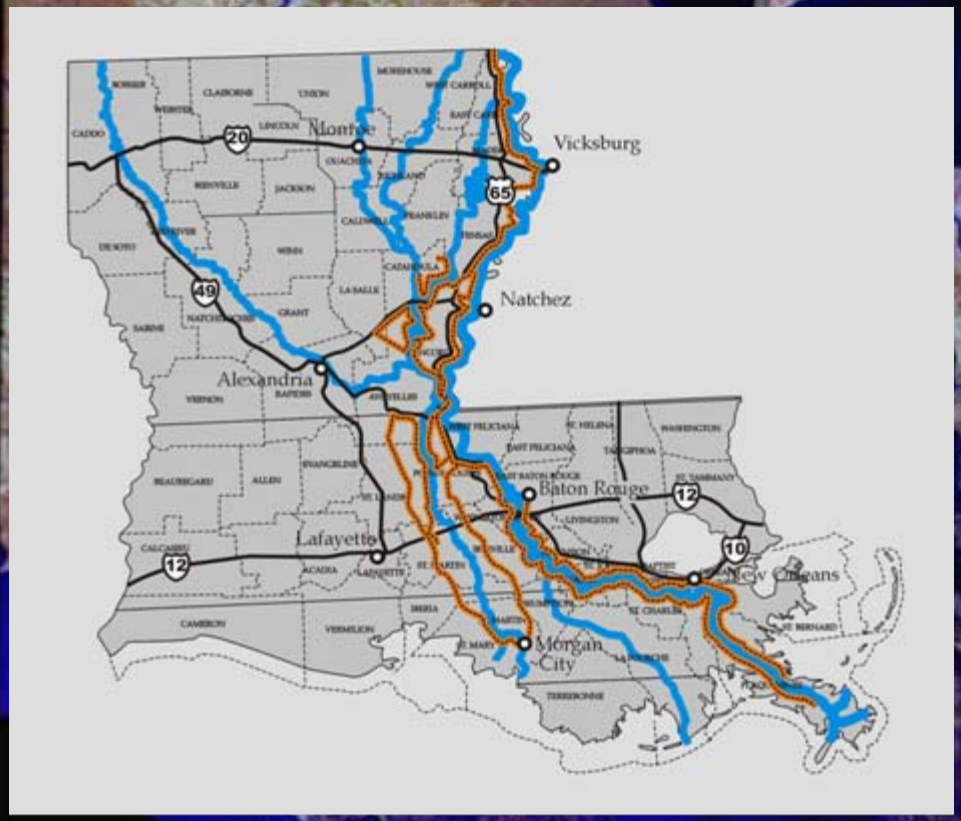
Lieutenant H. L. Abbot

Changes in the 20th Century: The Great Flood of 1927

- 246+ Deaths
- 325,000 Refugees
- 162,000 Homes Inundated
- 16.6 Million Acres Flooded

Mississippi River & Tributaries Project

Mississippi River &Tributaries Levee Project – 1997 Flood



- **With MR&T Levees**
  (Below Vicksburg, Miss.)

- **Without MR&T Levees**
  (Below Vicksburg, Miss.)

ALAS

Current river management stops
sediment load getting to coastal
wetlands and prevent new delta growth

Principles

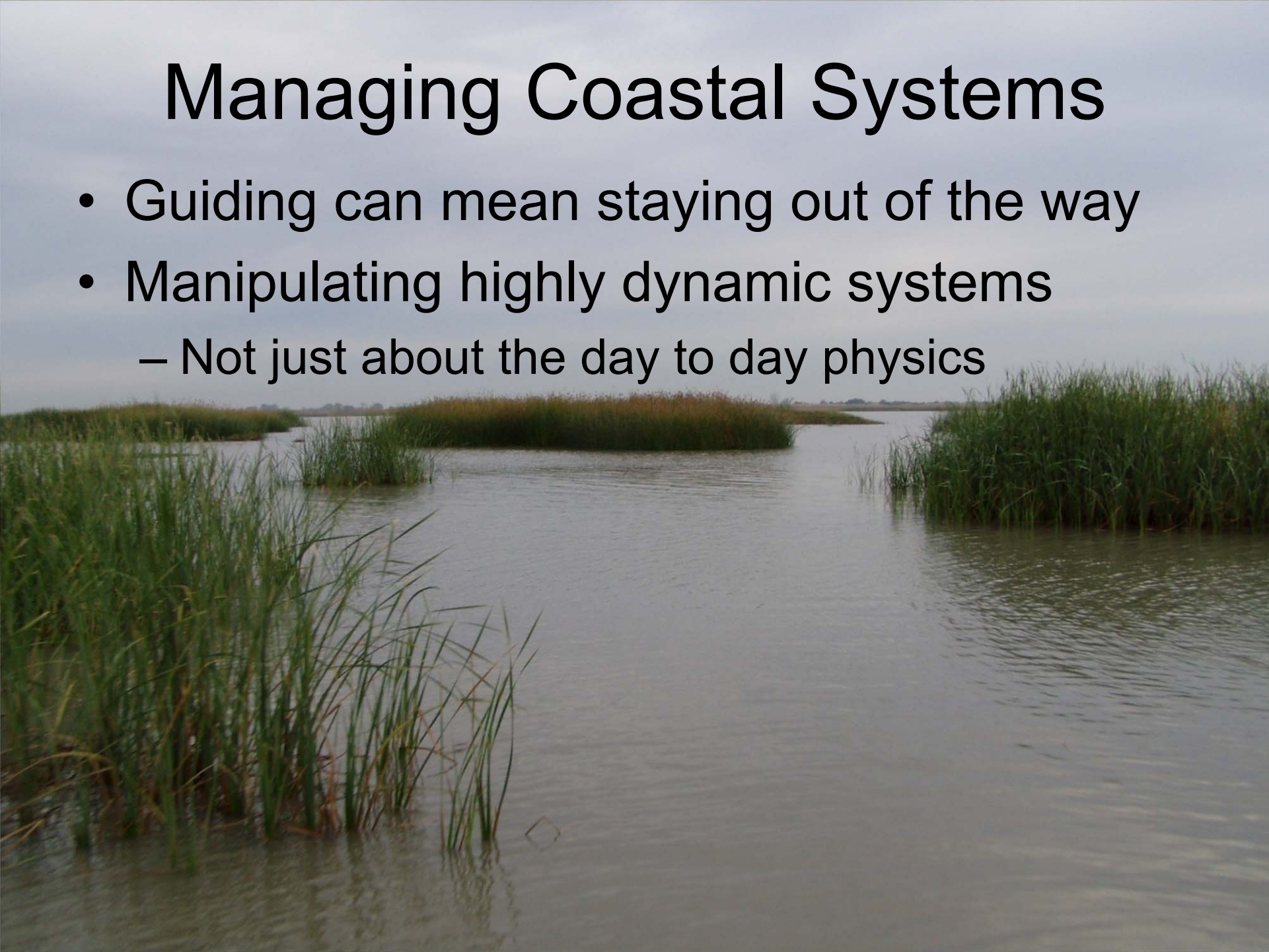
- Plan elements using mechanical sediment retrieval and placement may be considered where landscape objectives cannot be met with using natural processes….sediment mining can contribute to ecosystem degradation
- Protection and restoration alternatives that minimize long-term operation and maintenance costs will be preferred
- Appreciation of the dynamic nature of the coastal system must be integral to the planning and selection of preferred alternatives
- Design, construction, and operation of new flood and storm protection measures should avoid or minimize effects that would reduce ecosystem resilience

How to get there?

- By any means possible?
  - Recognize constraints
- Current vs. future context
  - Consider alternative futures
- System level impacts
  - Unintended consequences…

Managing Coastal Systems

- Guiding can mean staying out of the way
- Manipulating highly dynamic systems
  - Not just about the day to day physics



Marsh Management

…using levees and structures to control water exch

Marsh Management in LA

Landowners

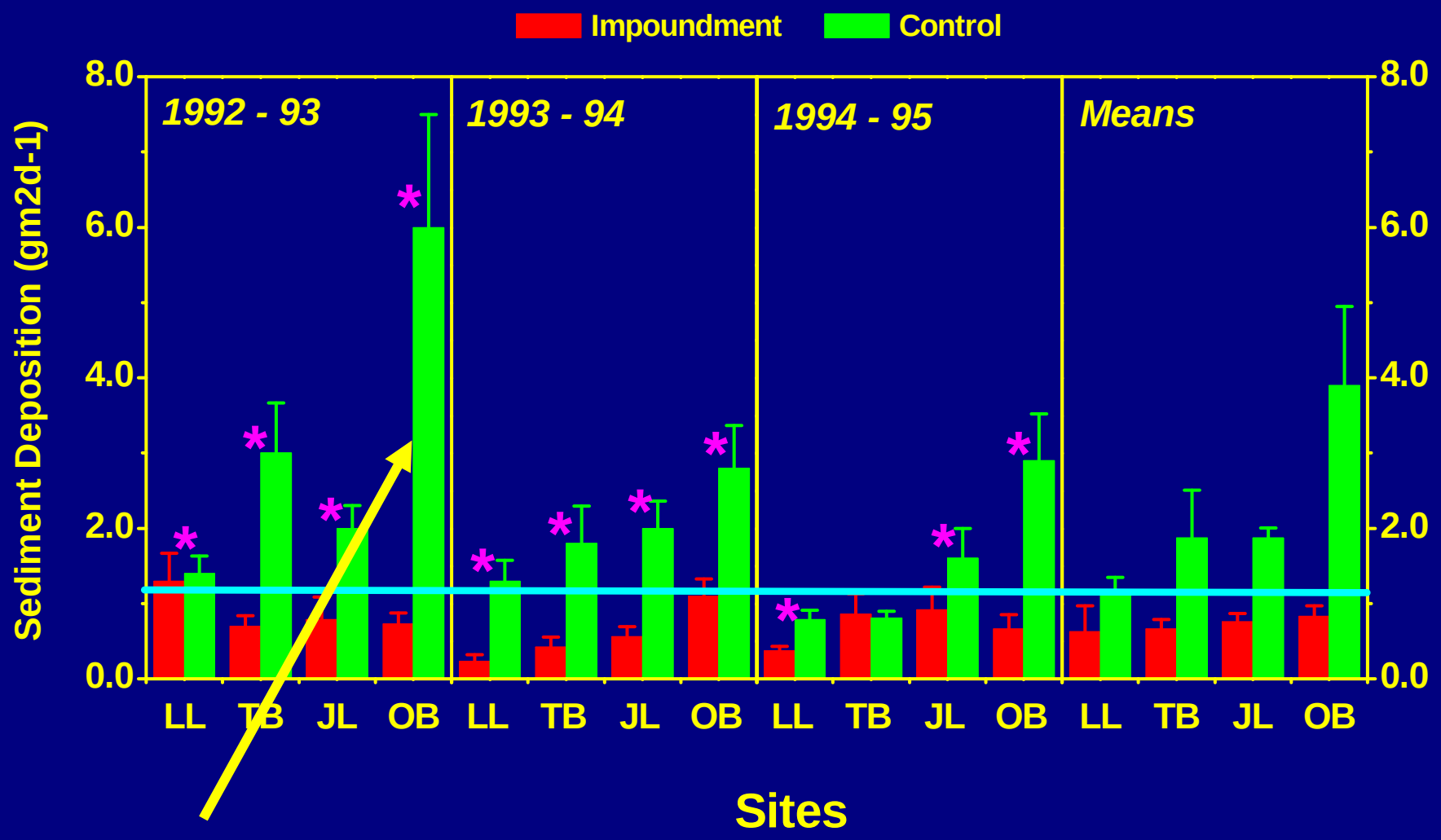
- Drawdown water levels in spring to encourage growth of annual plants
- Maintain water levels in Fall/Winter for waterfowl
- Prevent ‘washing away’ of ‘fragile marsh soils’
- Maintain boundaries around degraded marshes to maintain property rights – surface and subsurface!

What about Extremes?

"The ultimate success of a restored wetland as a functional ecosystem will depend on the level to which its reengineered or passively rejuvenated environment can endure natural disturbances."

Middleton 1999: Wetland Restoration—Flood Pulsing and Disturbance Dynamics

…..suggest that (ecological) functionality is typically <u>contingent</u> upon natural disturbance regime!



Hurricane Andrew

Reed et al., 1997

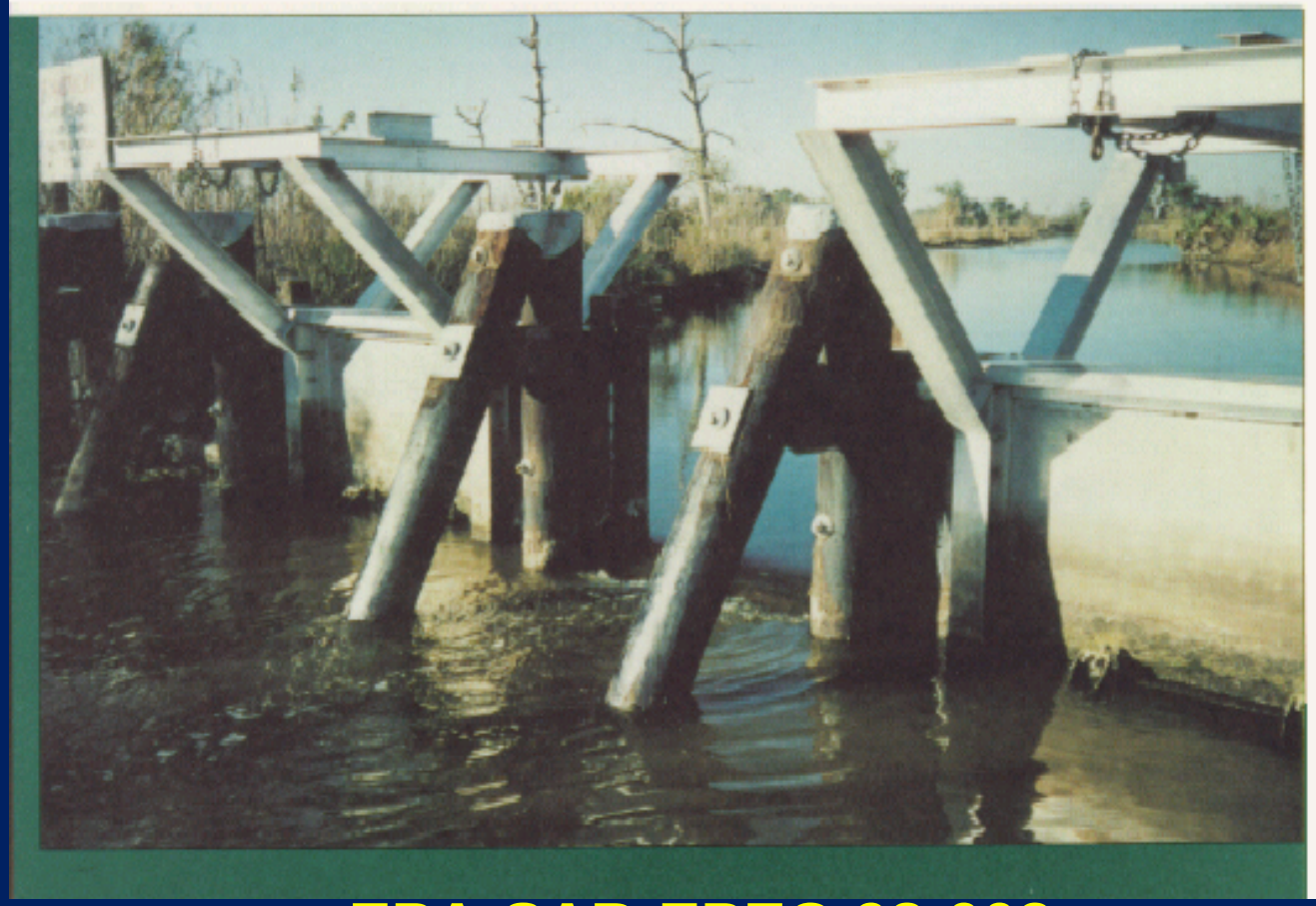
United States
Environmental Protection
Agency

Science Advisory Board

EPA-SAB-EPEC-98-003
January 1998
http://www.epa.gov/sab

EPA

Ecological Impacts And Evaluation Criteria For The Use Of Structures In Marsh Management



EPA-SAB-EPEC-98-003

EPA Science Advisory Board 1998

'….the collective experience around the country has shown that unintended, unanticipated, and sometimes undesirable effects have often resulted from structural management of marsh hydrology.' page 7

'The lesson from past SMM projects is that while it is relatively easy to change marsh hydrology, it is much more difficult to control or manage the changes or predict fully the consequences of proposed modifications.' page 20

Managing Coastal Systems

- Guiding can mean staying out of the way
  - Passive engineering vs. real time manipulation
- Manipulating highly dynamic systems
  - Variability matters

Expectations

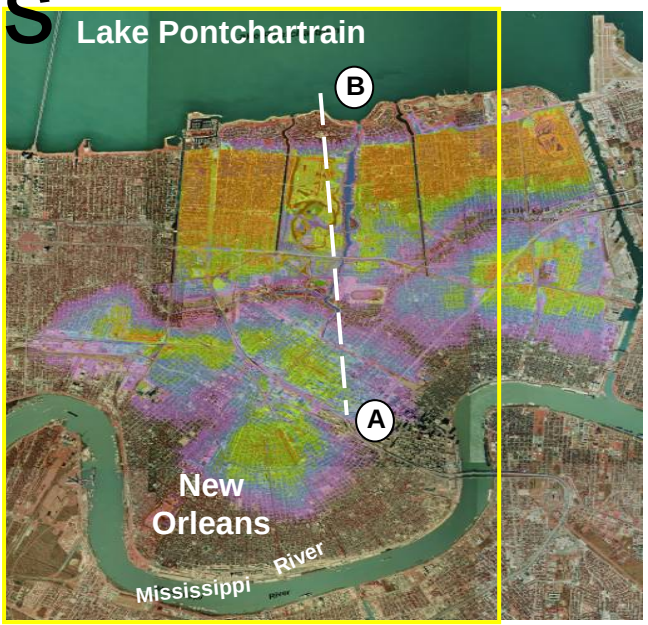
The Unexpected Happens

ASCE Calls to Action After Katrina

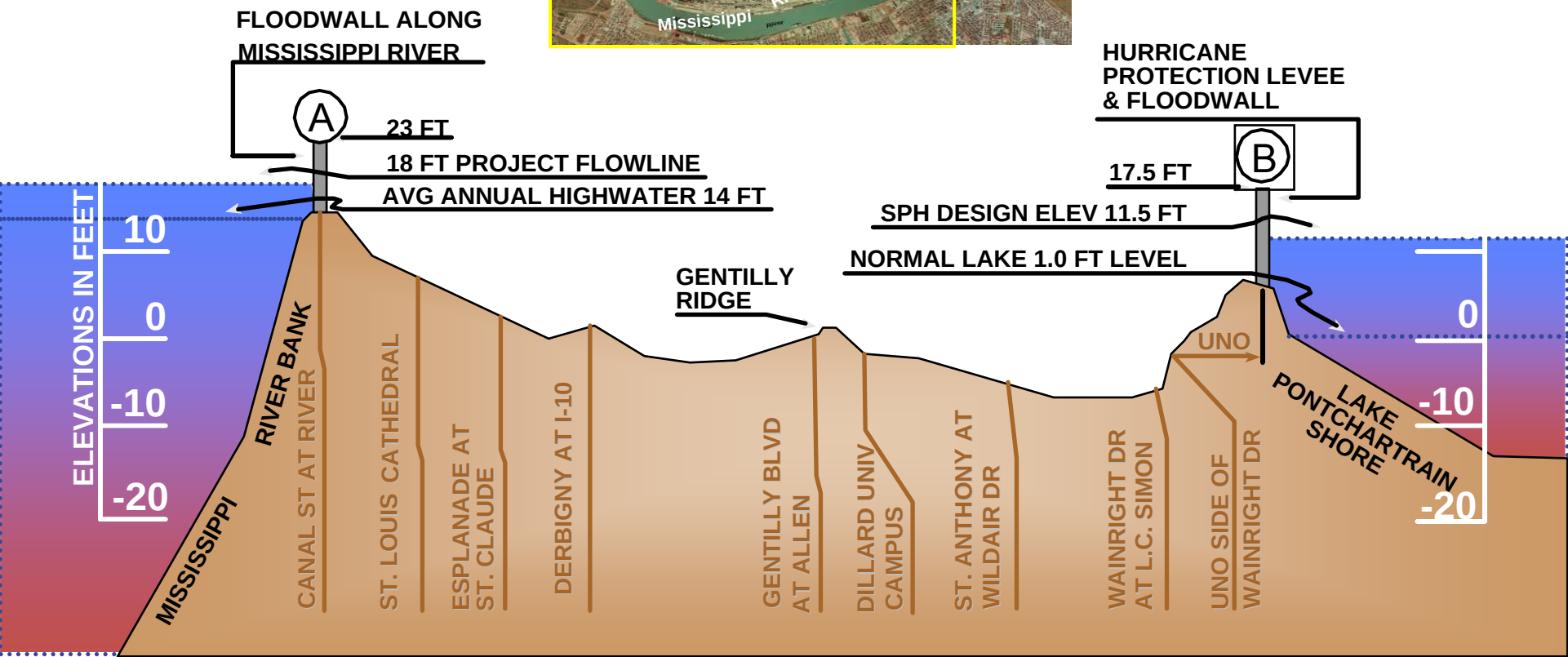
1	Keep safety at the forefront of public priorities
2	Quantify the risks
3	Communicate the risks to the public and decide how much is acceptable
4	Rethink the whole system, including land use
5	Correct the deficiencies
6	Put someone in charge
7	Improve inter-agency coordination
8	Upgrade engineering design procedures
9	Bring in independent experts
10	Place safety first

What Changes in the City?

City of New Orleans Ground Elevations



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



A New Framework for Planning the Future of Coastal Louisiana after the Hurricanes of 2005

by Working Group for Post-Hurricane Planning for the Louisiana Coast

January 26, 2006

Principal Message – Unified Approach

- No longer can coastal ecosystem management and restoration, flood protection, and navigation be planned, executed and maintained independently. We must *integrate planning, investment and management decisions under a new framework* in order to secure these multiple purposes

- Project planning should rely on *innovative decision-support analyses* that engage stakeholders and responsible agencies in resolution of conflicts and in identifying and synergies among projects.

System-level Analysis

natural science, social science, economics, and engineering

Proof of Concept

RAND Gulf States Policy Institute for USACE

Proof of Concept for USACE

- New Orleans and areas to the east
- Demonstrate approach for identifying and communicating measures that reliably achieve goals in face of uncertainties
  - Critical assumptions from ABP workshop
  - Integrated model
  - Robust decision-making methods

Assumption-Based Planning Workshop Documented Critical Assumptions as First Step Toward Identifying Robust Strategies

- More habitat means more species
- Federal flood insurance exists and won't change for 100 years
- Forces driving storm dynamics are well understood
- Land use patterns won't change
- Mississippi River provides enough sediment for restoration

Failure of load-bearing assumptions leads to failure of plan

Proof-of-Concept Analysis Looked at Effect of Key Uncertainties on Performance of Plans

- 100-yr hurricane intensity change
- Annual hurricane frequency change
- Sea level rise
- Ability of wetlands to reduce storm surge

- Cost of measures
- Engineering uncertainty
- Wetland creation rate
- Regional economic growth rate

Combining plans and uncertainties allows performance to be assessed across thousands of scenarios

Ecosystem Based Management?

Ecosystem-based management may often necessarily be a dispersed and collaborative activity, but the key is the focus on the whole ecosystem, defined in local, biophysical, and cultural terms, and on development of an *integrative* process for planning and management.

Slocombe 1998

The Role of Science

- Where do we want to go?
  - Objectives informed by technical understanding of system dynamics
- How are we going to proceed?
  - Approaches which don't repeat the unintended consequences of the past
- Managing coastal systems
  - Understanding variability across scales
- Expectations
  - Integrated analyses across biogeophysical science, engineering, economics and sociology