RESTORATION IN THE GULF OF MEXICO: STRATEGIES FOR MOVING FORWARD

Denise Reed
Vice President for Strategic Research Initiatives

THE WATER INSTITUTE OF THE GULF
OUTLINE

• Ecosystem Background & Location
• Major Resource Management Issues and/or Policy Drivers
• Science Investments Used to Guide Management
• Key Results of Science Investigations
• Successes and Challenges / Key Lessons Learned

Thanks to Alyssa Daussman, RESTORE Council
GULF OF MEXICO
RESTORE ACT, 2012

Subtitle F: Gulf Coast Restoration
Sec. 1601: Resource and Ecosystem Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act of 2012

Civil Penalties

- 80% to RESTORE Act Gulf Coast Restoration Trust Fund
- 20% to Oil Spill Liability Trust Fund
RESTORE Act Partnerships in the Gulf of Mexico
(Funded by 80% of Civil Penalties)

1603
1603(1) Council Establishment & Allocation
State Allocation & Expenditures
35%

1603(2) Oil Spill Restoration Impact Allocation
30%

1603(3) Natural Resources Damage Assessment & Trusts Council
Oil Spill Liability Trust Fund
20% of Civil Penalties

1604
Gulf Coast Ecosystem Restoration Science, Observation, Monitoring & Technology Program
2.5%

1605
CENTERS OF EXCELLENCE
2.5%

NGO
Funded by Criminal Penalties

Federal & International

Academic

Academic
Deepwater Horizon Gulf Science and Restoration Initiatives

Civil Penalties
- Trans/Anadarko ($1.16b)
- BP ($5.5b)

Criminal Penalties
- BP ($2.64b)
- Transocean ($300m)

Natural Resource Damages
- Responsible Parties-BP, etc.

RESTORE Act ($928m + $4.4b)
- Direct Component $1.86b
- Council Component $1.6b*
- Spill Impact Component $1.6b

North American Wetlands Conservation Fund ($100m)
- Alabama $356m

National Fish and Wildlife Foundation ($2.54b)
- Louisiana $1.3b
- Florida $356m
- Mississippi $356m

National Academy of Sciences ($500m)
- Louisiana
  - $4.059b to restore and conserve habitat
  - $20m restore water quality
  - $256m replenish and protect LMCR
  - $225m adaptive mgmt.
- Louisiana
  - $350m Regionwide Oysters
  - $64m Oysters
  - $270m Birds
  - $700m Unknown Conditions

Spill Impact Component $1.6b

Centers of Excellence $133m*

NOAA Science Program $133m*

Texas $356m

Other Initiatives
- Gulf of Mexico Research Initiative ($500m)
- NOAA Science Program
- Centers of Excellence
- NOAA Science Program
- Responsible Parties-BP, etc.
- BP Early Restoration (up to $1b)
- Nat. Res. Damages ($7.1B+0.7B)
- Oregon
  - $64m Oysters
  - $70m Birds
  - $700m Unknown Conditions

Responsible Parties-BP, etc.

Washington
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Louisiana
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Gulf Coast Ecosystem Restoration Council

• Independent federal entity

• Composition:
  • Governors of Alabama, Florida, Louisiana, Mississippi & Texas
  • Secretaries of Agriculture, Army, Commerce, Homeland Security, Interior, Administrator of the EPA

• Voting structure

• Funding to members

Catherine Hibbard, USFWS
Goals

1. Restore & Conserve Habitat
2. Restore Water Quality & Quantity
3. Replenish & Protect Living Coastal & Marine Resources
4. Enhance Community Resilience
5. Restore & Revitalize the Gulf Economy

Update at least every 5 years as per the Act
Comprehensive Plan Update

- Builds on successes, lessons, & provides strategic guidance
- Promotes collaboration
- Commits to update science review process
- Improve delivery of ecosystem science, monitoring, & data management across disciplines to report on restoration
- Adaptive Management Plan
- Positions Council for effective use of future funds
- Coordinates holistic, large-scale restoration
- Improves efficiency, effectiveness & transparency
...coastal Louisiana has undergone a net change in land area of about -1,883 square miles (mi²) from 1932 to 2010. This net change in land area amounts to a decrease of about 25 percent of the 1932 land area. ... 1985 to 2010 show a wetland loss rate of 16.57 mi²/year. 

Couvillion et al. (2011)
Historic Land-Water Change from 1932-2010
Couvillion et al (USGS), 2011
PREVIOUS COASTAL PLANNING EFFORTS

- ‘Vegetative wetlands’
- Project by project
- Strategic in nature
- Principles of ‘how’ to restore
- Began as a comprehensive approach
- Scaled down to unconnected individual projects
- Focus on protection
- Use of multi-criteria decision analysis
STATE MASTER PLAN – AN INTEGRATED APPROACH

- First real attempt at integration
- Developed in 18 months with existing information
- Recognized the challenges and trade-offs
2012 COASTAL MASTER PLAN

- Built on science and engineering
- Evaluated hundreds of existing project concepts
- Resource constrained
  - Funding, water, sediment
- Identified investments that will pay off in the long run
SO WHY ANOTHER PLAN?

• It’s required by law to be updated every five years

• Allows the state to respond to changes on the ground and public input as well as innovations in science, engineering, and policy

• Advances a comprehensive and integrated approach to protecting and restoring the communities of Coastal Louisiana
WHAT’S DIFFERENT ABOUT THE 2017 COASTAL MASTER PLAN?

• Improved science and technical analysis
• Incorporating new ideas and information
• Focus on flood risk reduction and resilience
• Emphasis on communities
• Expanded outreach and public engagement
• Expedited funding scenarios and implementation timelines
### MASTER PLAN OBJECTIVES

<table>
<thead>
<tr>
<th>Category</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flood Protection</td>
<td>Reduce economic losses from storm-based flooding</td>
</tr>
<tr>
<td>Natural Processes</td>
<td>Promote a sustainable coastal ecosystem by harnessing the processes of the natural system</td>
</tr>
<tr>
<td>Coastal Habitats</td>
<td>Provide habitats suitable to support an array of commercial and recreational activities coast wide</td>
</tr>
<tr>
<td>Cultural Heritage</td>
<td>Sustain Louisiana’s unique heritage and culture</td>
</tr>
<tr>
<td>Working Coast</td>
<td>Provide a viable working coast to support industry</td>
</tr>
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</table>
DEVELOPING THE COASTAL MASTER PLAN

COASTAL PROJECTS
- Identify candidate projects

PREDICTIVE MODELS
- Model projects
- Model alternatives

PLANNING TOOL
- Compare projects & develop alternatives
- Compare alternatives

OUTREACH & ENGAGEMENT
ENVISIONING THE FUTURE COAST

PREDICTIVE MODELS

INTEGRATED COMPARTMENT MODEL
- Eco-Hydrology
- Barrier Island Morphology
- Wetland Morphology
- Vegetation
- Ecosystem Outcomes

SURGE/WAVES AND RISK ASSESSMENT MODEL
- Storm Surge/Waves
- Risk Assessment

ENVIRONMENTAL AND RISK SCENARIOS
- Precipitation
- Evapotranspiration
- Subsidence
- Sea Level Rise
- Storm Frequency
- Storm Intensity
# Planning for an Uncertain Future

## Environmental Scenarios Considered

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Precip</th>
<th>ET</th>
<th>Sea Level Rise</th>
<th>Subsidence</th>
<th>Storm Frequency</th>
<th>Avg. Storm Intensity</th>
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</thead>
<tbody>
<tr>
<td><strong>Low</strong></td>
<td>&gt;Historical</td>
<td>&lt;Historical</td>
<td>1.41’</td>
<td>20% of range</td>
<td>-28%</td>
<td>+10.0%</td>
</tr>
<tr>
<td><strong>Medium</strong></td>
<td>&gt;Historical</td>
<td>Historical</td>
<td>2.07’</td>
<td>20% of range</td>
<td>-14%</td>
<td>+12.5%</td>
</tr>
<tr>
<td><strong>High</strong></td>
<td>Historical</td>
<td>Historical</td>
<td>2.72’</td>
<td>50% of range</td>
<td>0%</td>
<td>+15.0%</td>
</tr>
</tbody>
</table>

*(FEET/50 YEARS)*
DECISION DRIVERS FOR PROJECT SELECTION

REDUCING FLOOD RISK

BUILDING LAND
BUilt on the best available science..

**Planning Tool**

**Decision Drivers**
- Reducing flood risk
- Building land

**Metrics**

**Community Metrics**
- Agricultural communities
- Flood protection of strategic assets
- Oil & gas communities
- Social vulnerability

**Environmental Metrics**
- Alligator
- Crawfish
- Saltwater fisheries
- Use of natural processes
- Blue crab
- Freshwater fisheries
- Shrimp
- Waterfowl
- Brown pelican
- Oysters
- Sustainability of land

**Constraints**
- Sediment
- Funding
TECHNICAL TEAM
COLLABORATIVE TEAM OF OVER 70 EXPERTS

LSU
Deltares
Louisiana State University
USGS
Moffatt & Nichol
Coastal Engineering Consultants Inc.
CBI
Dynamic Solutions LLC
Unive of New Orleans
Arçadis
The University of Southern Mississippi
Rand Corporation
Southeastern Louisiana University
Fenstermaker
Ecopath
<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
<th>Expertise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carl Friedrichs</td>
<td>VIMS, William &amp; Mary</td>
<td>Coastal Geoscience</td>
</tr>
<tr>
<td>Dan Childers</td>
<td>Arizona State University</td>
<td>Wetlands</td>
</tr>
<tr>
<td>Ed Houde</td>
<td>University of Maryland</td>
<td>Fisheries</td>
</tr>
<tr>
<td>Jen Irish</td>
<td>Virginia Tech</td>
<td>Risk</td>
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<tr>
<td>Len Shabman</td>
<td>Resources for the Future</td>
<td>Economics</td>
</tr>
<tr>
<td>Margaret Davidson</td>
<td>NOAA</td>
<td>Natural Resource/Economic Policies</td>
</tr>
<tr>
<td>Marius Sokolewicz</td>
<td>Royal Haskoning</td>
<td>Coastal Modeling</td>
</tr>
<tr>
<td>Michael Orbach</td>
<td>Duke University</td>
<td>Socio-Economics</td>
</tr>
<tr>
<td>Sandra Knight</td>
<td>WaterWonks, LLC</td>
<td>Water Resources</td>
</tr>
<tr>
<td>William Fulton</td>
<td>Rice University</td>
<td>Urban Planning</td>
</tr>
</tbody>
</table>
TECHNICAL ADVISORY COMMITTEES

Predictive Models
- John Callaway, University of San Francisco
- Scott Hagen, Louisiana State University
- Courtney Harris, Virginia Institute of Marine Sciences
- Wim Kimmerer, San Francisco State University
- Mike Waldon, US Fish and Wildlife Services (retired)

Resiliency
- Daniel Aldrich, Northeastern University
- Diane Austin, University of Arizona
- Gavin Smith, University of North Carolina
- Dan Zarrilli, City of New York, Mayor’s Office of Recovery & Resiliency
SOURCES OF SCIENCE

- Universities
- Agencies
- Research institutes/NGOs
- Private sector
- Few coordinating mechanisms
A LONG HISTORY OF RESEARCH
COASTWIDE REFERENCE MONITORING SYSTEM

Coastwide Reference Monitoring System

Single-click the yellow symbology on the map to view CRMS Site information.
FUNDING FOR SCIENCE

Specific support for coastal research is limited.
Programmatic monitoring provides baseline.
Project-specific opportunities, e.g., Master Plan.
Deepwater Horizon Gulf Science and Restoration Initiatives

**Civil Penalties**
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**Natural Resource Damages**
- Responsible Parties-BP, etc.
- NRDA Trustee Council
  - BP Early Restoration (up to $1b)
  - Nat. Res. Damages ($7.1b+0.7b)

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Request for Proposals issued November 2017
~$3m

Research to support implementation of the Coastal Master Plan
SCIENTIFIC TOOLS

- Monitoring
- Investigative Research
- Modeling
COASTAL MASTER PLAN EVALUATED OF HUNDREDS OF EXISTING PROJECTS

Nearly 400 Projects Evaluated Across the Coast
DECISION DRIVERS

- Flood Risk Reduction and Land Built/Maintained as Decision Drivers

Risk Reduction

Expected Annual Damages

Restoration

Land Area
INTEGRATED COMPARTMENT MODEL (ICM)
FUTURE WITHOUT ACTION
HIGH SCENARIO | YEAR 30
WHAT THE PLAN DELIVERS: LAND CHANGE
HIGH SCENARIO | YEAR 30

[Map showing land change with legend for Land Lost, Land Gained, Land Sustained]
FUTURE WITHOUT ACTION
HIGH SCENARIO | YEAR 50
WHAT THE PLAN DELIVERS: LAND CHANGE
HIGH SCENARIO | YEAR 50
WHAT THE PLAN DELIVERS
LAND GAINED/SUSTAINED

POTENTIAL LAND GAINED/SUSTAINED OVER TIME  FUTURE WITH ACTION

SQUARE MILES

11  241  481  1036  1158
YEAR 10  YEAR 20  YEAR 30  YEAR 40  YEAR 50

SCENARIO
HIGH
FUTURE WITHOUT ACTION: FLOOD DEPTHS
MEDIUM SCENARIO | YEAR 25 | 100-YEAR EVENT
WHAT THE PLAN DELIVERS: FLOOD DEPTHS
MEDIUM SCENARIO | YEAR 25 | 100-YEAR EVENT
WHAT THE PLAN DELIVERS: FLOOD DEPTH DIFFERENCE
MEDIUM SCENARIO | YEAR 25 | 100-YEAR EVENT
FUTURE WITHOUT ACTION: FLOOD DEPTHS
MEDIUM SCENARIO | YEAR 50 | 100-YEAR EVENT

Flood Depths
- 1-3 ft
- 4-6 ft
- 7-9 ft
- 10-12 ft
- 13-15 ft
- Over 15 ft

Map showing flood depths in different colors for a future scenario without action.
WHAT THE PLAN DELIVERS: FLOOD DEPTHS
MEDIUM SCENARIO | YEAR 50 | 100-YEAR EVENT
WHAT THE PLAN DELIVERS
REDUCTION IN EXPECTED ANNUAL DAMAGES

EXPECTED ANNUAL DAMAGES

BILLIONS

CURRENT

YEAR 25

YEAR 50

FUTURE WITHOUT ACTION
FUTURE WITH ACTION

$2.7B

$5.3B

$2.2B

$12.1B

$3.7B

$3B

$8.3B

REDUCED

REDUCED
2017 Coastal Master Plan Appendices

To access the appendices to the 2017 Coastal Master Plan, please click the links below. If you have any questions regarding the appendices, please e-mail us at MasterPlan@la.gov.

Appendix A: Project Definition
Appendix B: People and the Landscape
Appendix C: Modeling (by chapter below)
Appendix D: Planning Tool
Appendix E: Flood Risk and Resilience Program Framework
Appendix F: Adaptive Management
Appendix G: Outreach and Engagement
MOVING PROJECTS TO IMPLEMENTATION
PROJECT LEVEL ANALYSIS - SEDIMENT DIVERSIONS

- Mid-Barataria (75,000 CFS)
- Mid-Breton (35,000 CFS)
- Lower Barataria (50,000 CFS)
- Lower Breton (50,000 CFS)
DELTA KNOWLEDGE

(a) Fluvial- and wave-dominated deltas (e.g.) Mississippi River, Yellow River
(b) Tide-dominated Changjiang delta

Fig. 10: Schematic illustration of delta switching.

Hori, 2002

% SAND

WATER DEPTH (%)

- VERY FINE SAND (62-125 μm)
- FINE SAND (125-250 μm)
- MEDIUM SAND (250-500 μm)

Allison & Meselhe 2013

Roberts, 1998
DIVERSION MODEL OVERVIEW

- D-FLOW
  - Hydrodynamics
  - Morphodynamics
  - Vegetation Dynamics

- D-WAQ
  - Nutrient Dynamics

- D-FLOW-SED-ONLINE

VEGMOD +LAVegMod.DM+LAVegMod.RootShoot

Black: Existing Components
Green: New Developments

EwE & CASM

Food Webs
LAND CHANGE BY YEAR 2070
ALL DIVERSIONS

Net Land Gain
40,500 acres

All Diversions Year 50
Landscape Change Referenced to FWOP
- Land Loss
- Land Sustained
- Land Gained

0 3 6 12 18 24 Miles
LAND CHANGE BY YEAR 2070
MID DIVERSIONS

Net Land Gain
34,200 acres
CHALLENGES / KEY LESSONS LEARNED

• No formal mechanisms for cross-discipline/cross institution discussion of how science can help
• Lack of opportunity to synthesize outside of modeling
• Non-agency scientists leverage other sources, e.g., NSF
  – reviewers aren’t always looking for what might be locally relevant
• Developing ideas on ‘adaptive management’ may provide an opportunity for ‘collective’ input from scientists
THANK YOU

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