Using Science to Inform Decision Making in the Face of Uncertainty: A Tool for Prioritizing Coastal Restoration and Protection Projects in Louisiana

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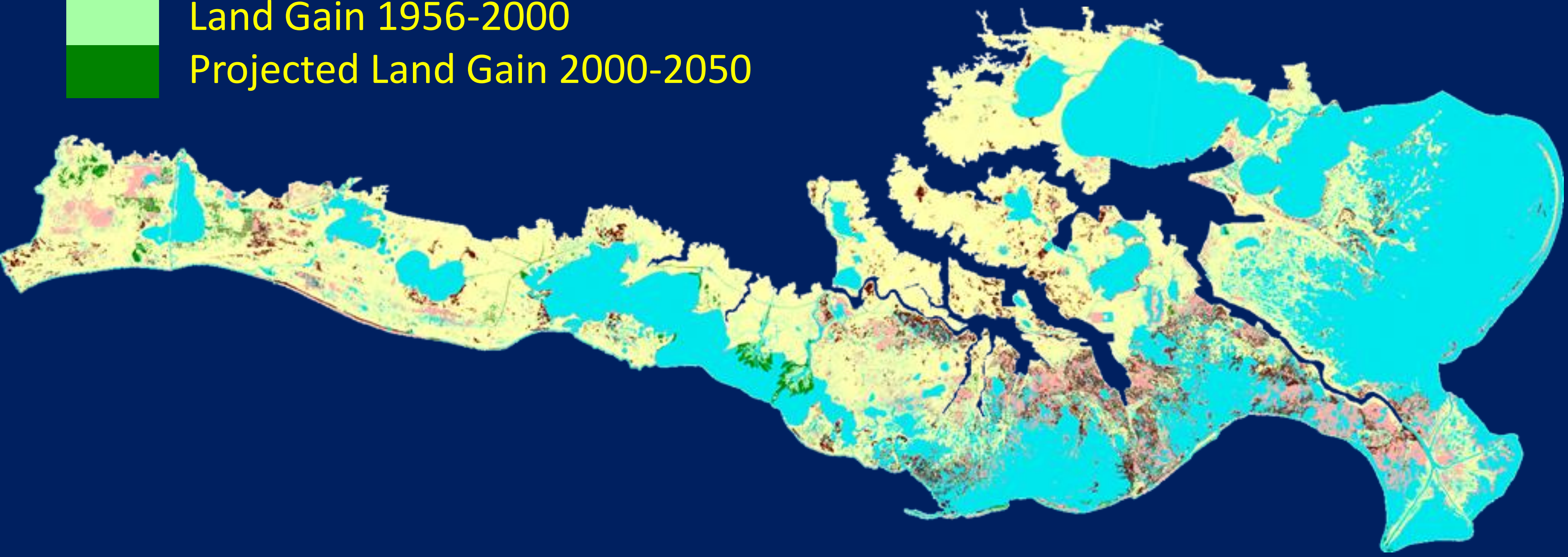
Projected Coastal Louisiana Trends: 1956-2050

Land Loss 1956-2000
Projected Land Loss 2000-2050

Land
Water

Land Gain 1956-2000
Projected Land Gain 2000-2050

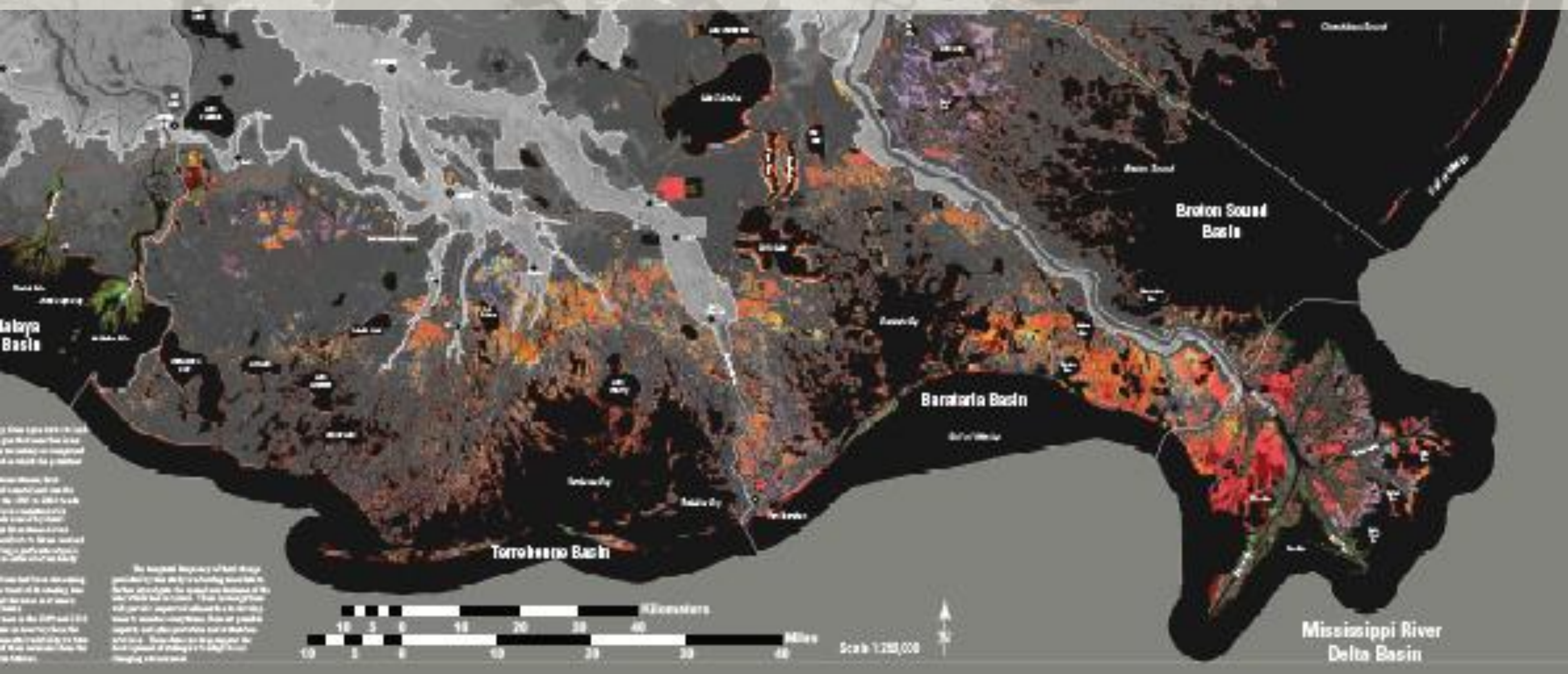


1956 – 2000 1525 sq. mi. of coastal landscape lost
average rate 35 sq.mi./yr. for 44 years

2000 – 2050 Projected loss - another 513 square miles

These analyses show that coastal Louisiana has undergone a net change in land area of about -1,883 square miles (mi^2) from 1932 to 2010. This net change in land area amounts to a decrease of about 25 percent of the 1932 land area. ….Trend analyses from 1985 to 2010 show a wetland loss rate of 16.57 mi^2 per year.

Couvillion et al. (2011)



Approach Provides Analysis to Address Key Planning Questions

- What investments should the state, in coordination with local and Federal agencies, make to achieve the goals of the Master Plan
  - Which investments?
  - What financial resources are required?
  - What outcomes can be achieved?
  - Can the plan be robust over time to uncertain future conditions?

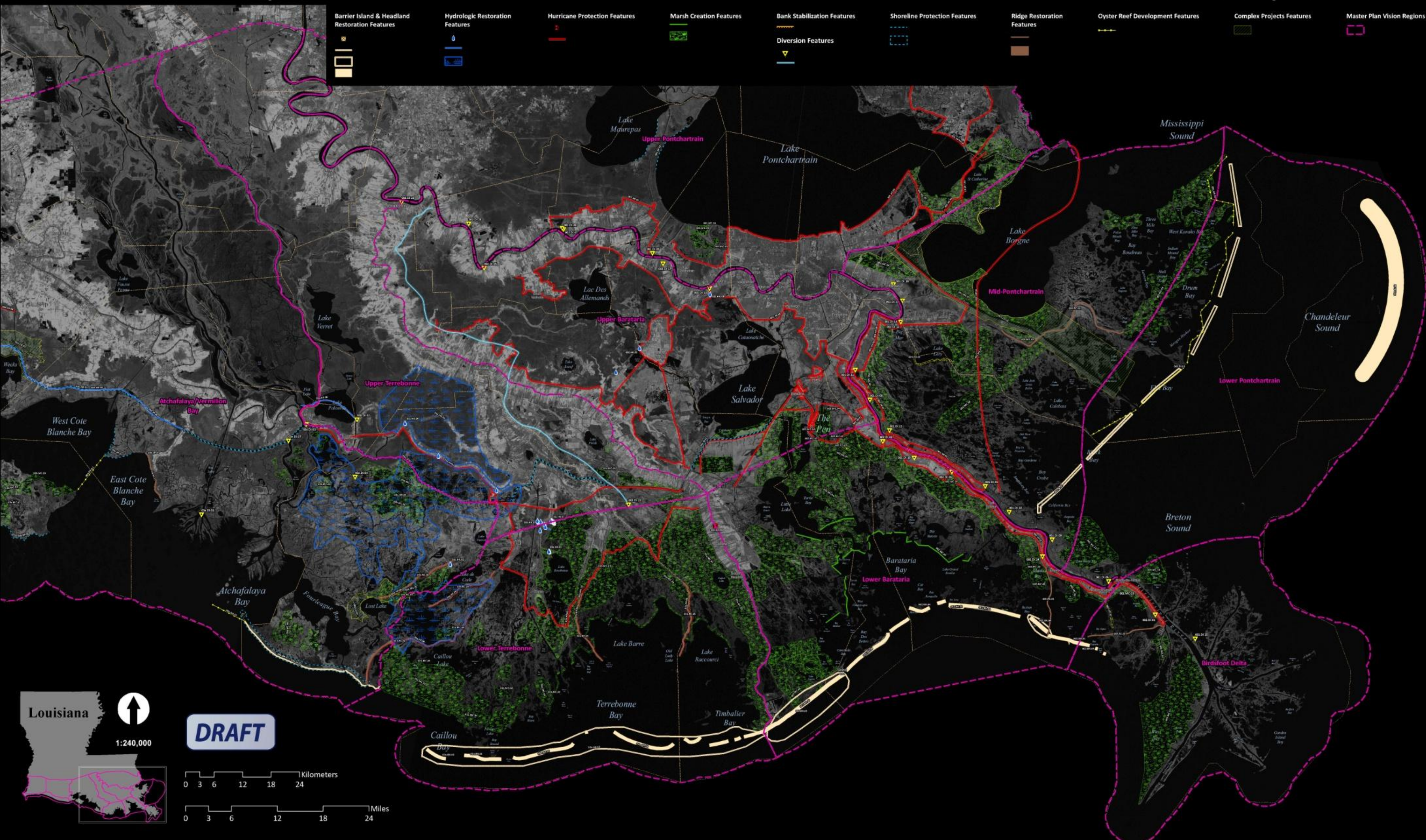
Answers Difficult……

1. Large set of possible projects
   – Hundreds of individual projects could be assembled to create thousands to millions of different alternatives
   – Interactions among projects can be significant
2. Significant uncertainty about future conditions and the effects of projects
   – Estimating outcomes requires sophisticated models
   – No single estimate is credible
3. Range of views on desired outcomes
   – Different values for diverse stakeholders

CPRA 2012 Master Plan Update

Eastern Region

Prioritization Project Candidates



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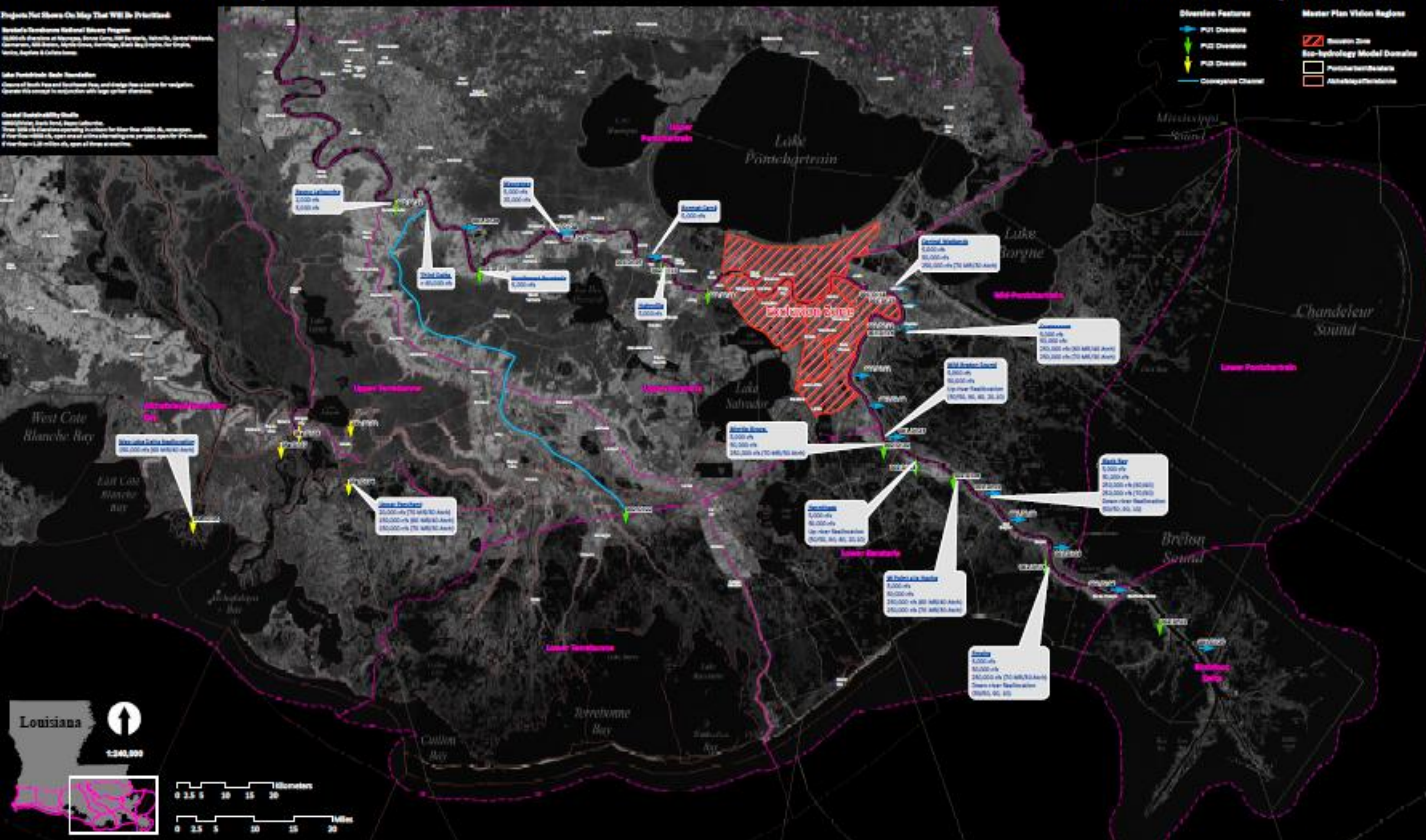
Diversions

Prioritization Project Candidates



Uncertainties

Uncertainty	Range
Sea Level Rise	**Low SLR** = 0.0031 m by 2099 **High SLR** = 1.501 m by 2099
Subsidence	**1-35mm/yr** (varies spatially coast wide)
Storm intensity/ frequency	**Frequency** – varies around 0.03–0.04 storms/deg/yr **Intensity –** shifting the probability distribution for central pressure upwards
River discharge	**Low-** 7% decrease in total discharge **High -** 14% increase in discharge
Nutrient loading	**Low** – EPA target -reduce N & P by 45% by 2015 **High** – estimate 20% increase in nutrients
Rainfall/ Evapo-Transpiration	+/- 1SD of historical record
Marsh Collapse Threshold	Expert Panel derived ranges of salinity/flooding

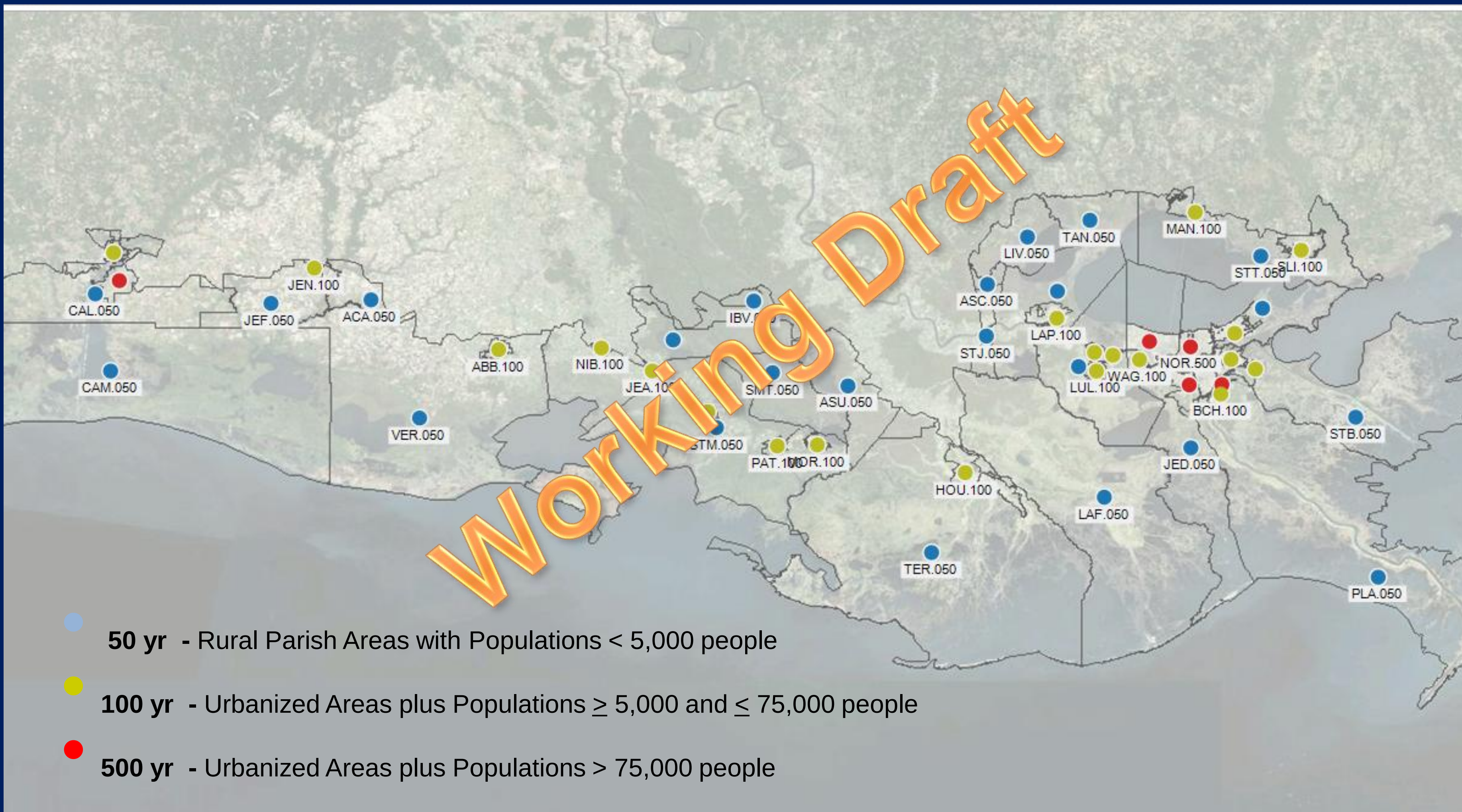
1) Define a future vision for the coast

- Vision articulates desired future coastal outcomes
  - Provides reference for success
  - Establishes means to compare progress across metrics
- Two key components:
  - Metrics (protection & ecosystem services)
  - Targets (quantified levels for each metrics)

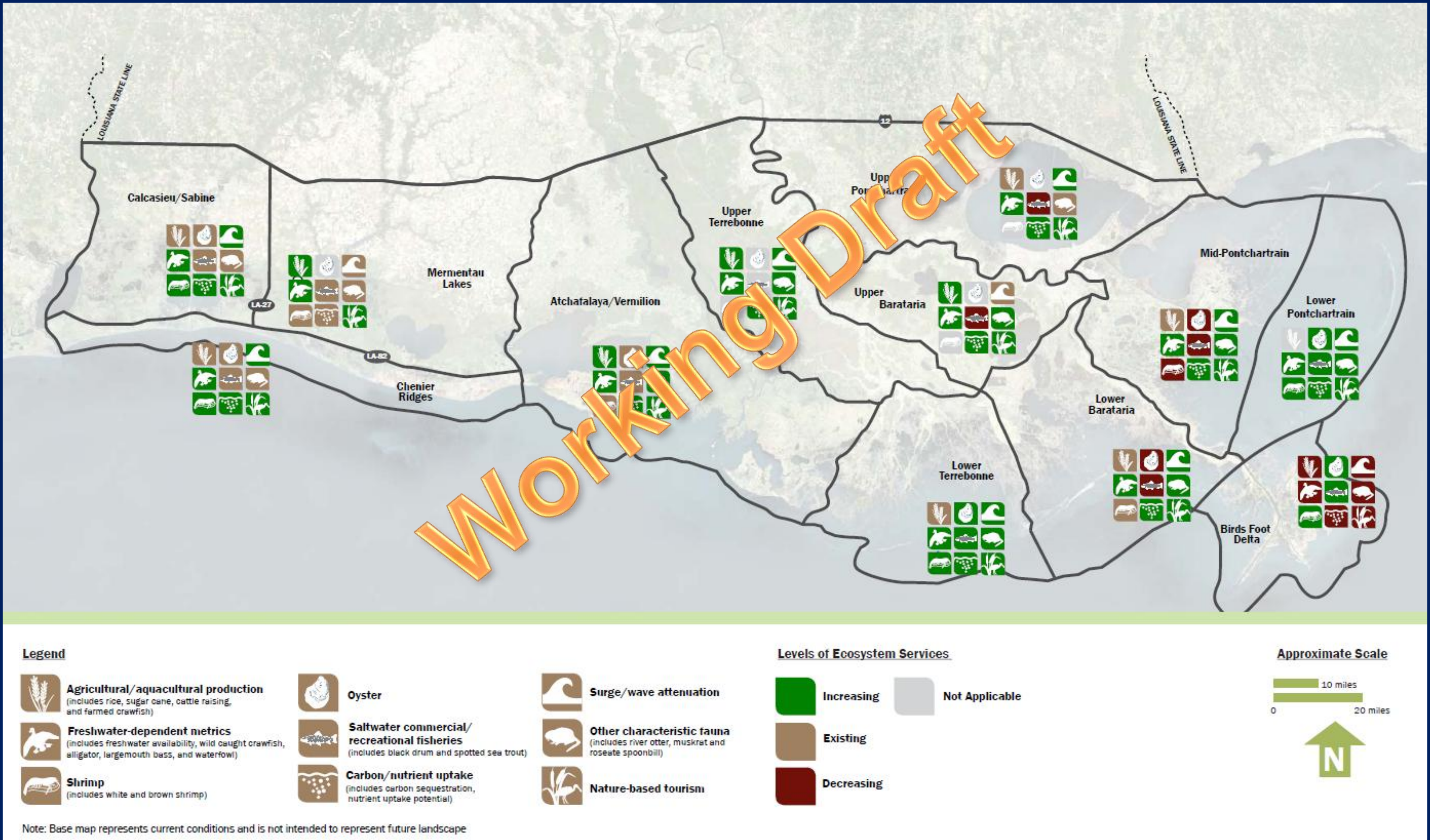
Why We Need a Vision

- Past plans guided by broad goals and objectives - missing a common view about what we want to achieve
- Vision guides protection and restoration efforts and benchmarks progress
- *Pragmatism*- Cannot recreate the pre-1927 coast
  - Vision based on what is possible, not what is ideal
- *Clarity*- Some areas cannot be protected or restored
  - Clear about competing priorities and tradeoffs

Storm Surge & Wave Risk Reduction Target Areas

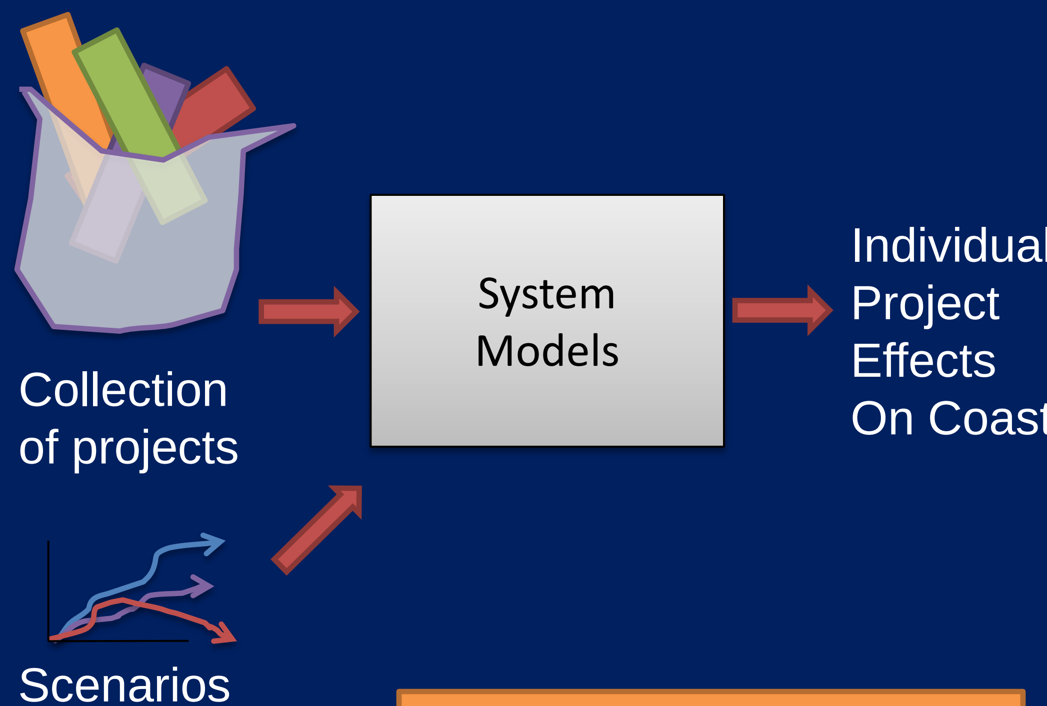


Restoration Targets *(Ecosystem Service Metrics)*



2) Estimate individual project effects on the coast

- Objective, scientifically-based project assessment
- System models:
  - Evaluate progress towards vision
  - Balance level of detail against evaluation time
- Scenarios reflect uncertainty

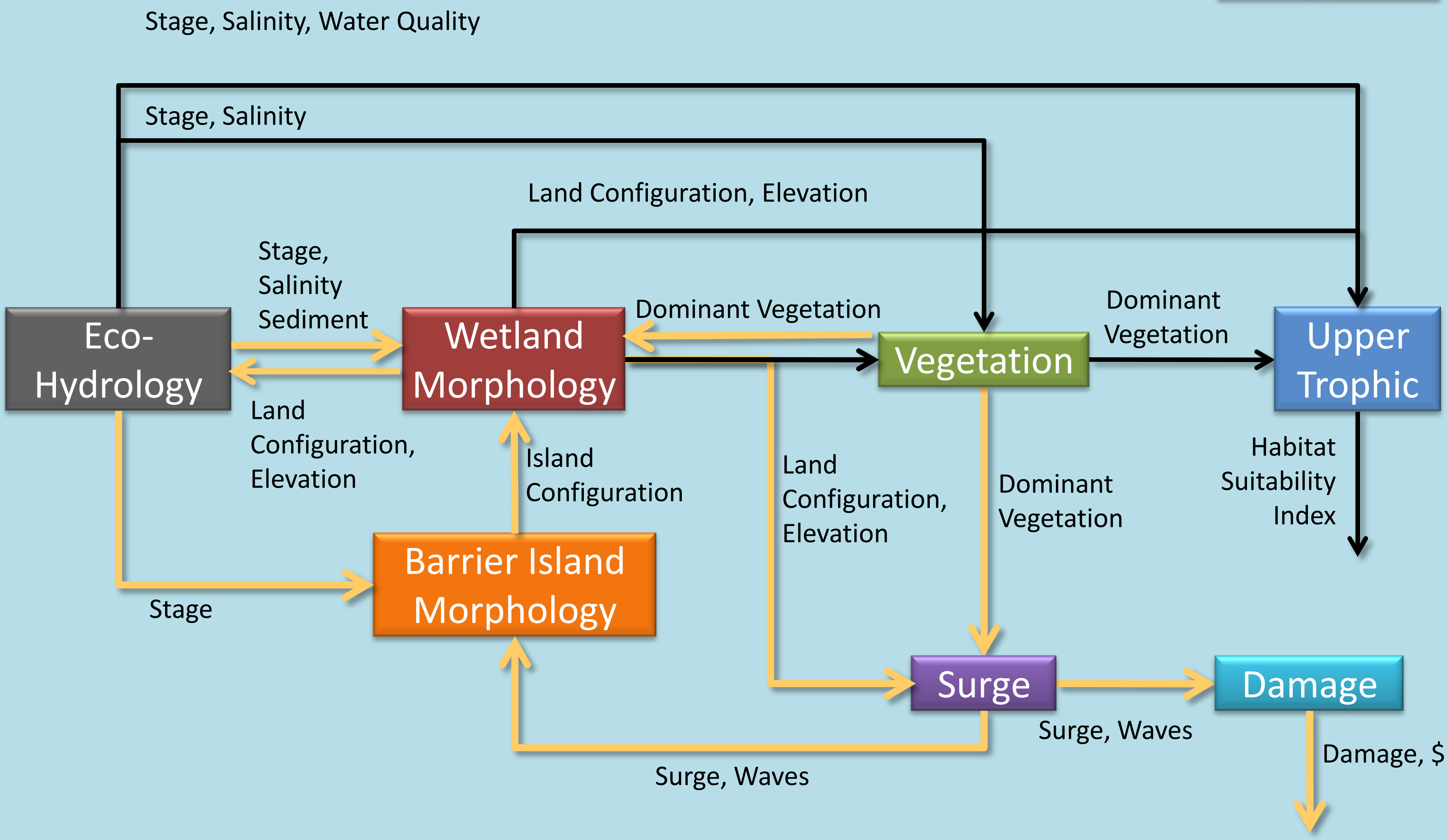


Why individual projects?

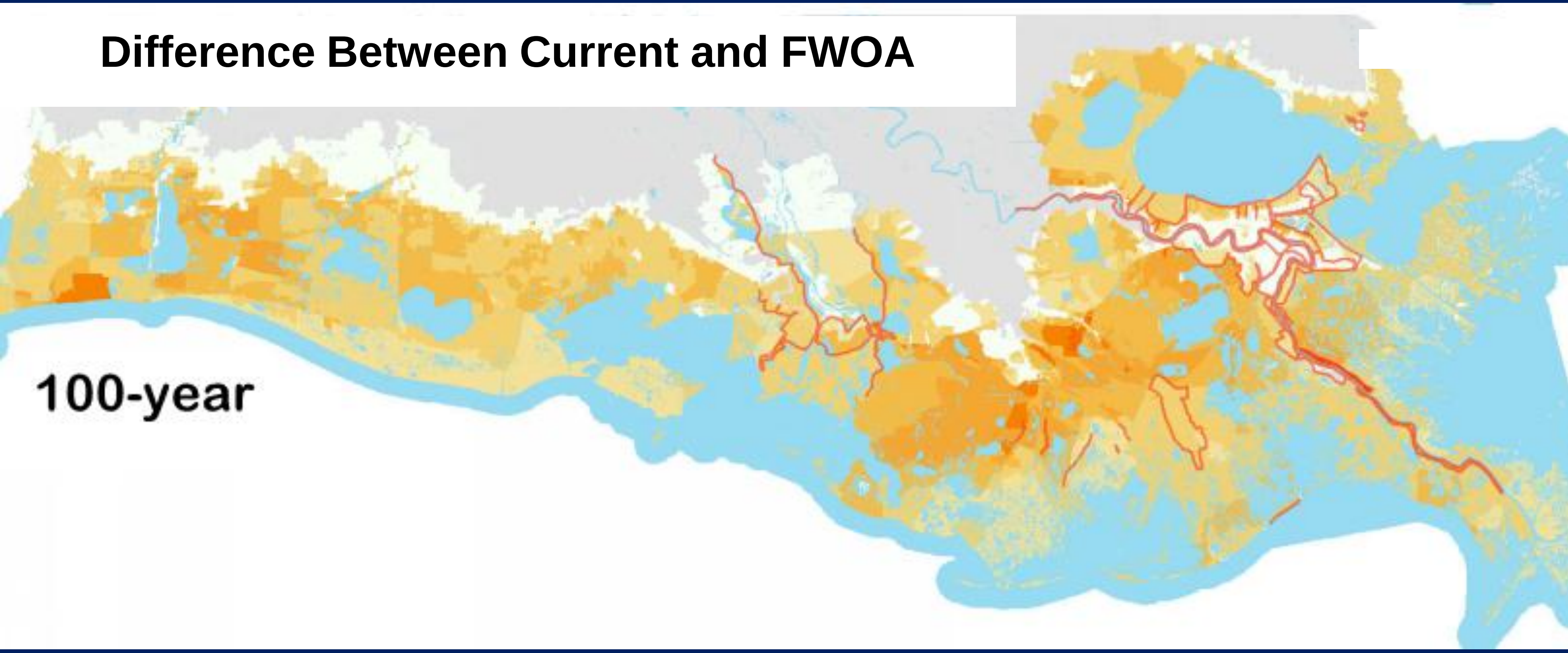
- Too many potential combinations of projects at this stage

Modeling: Predict Changes in Restoration Metrics

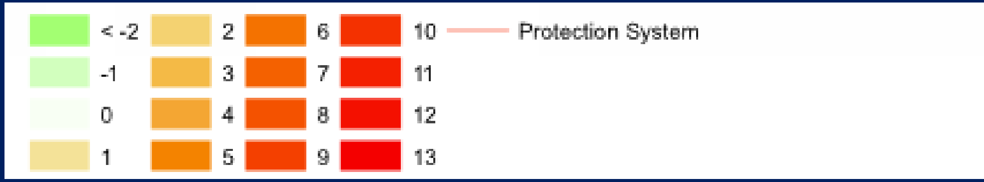
Data Integration



Change in Flood Depths – 100 year



Change in Flood Depth



Assumptions:
- 100% Pumping
- Nominal Fragility

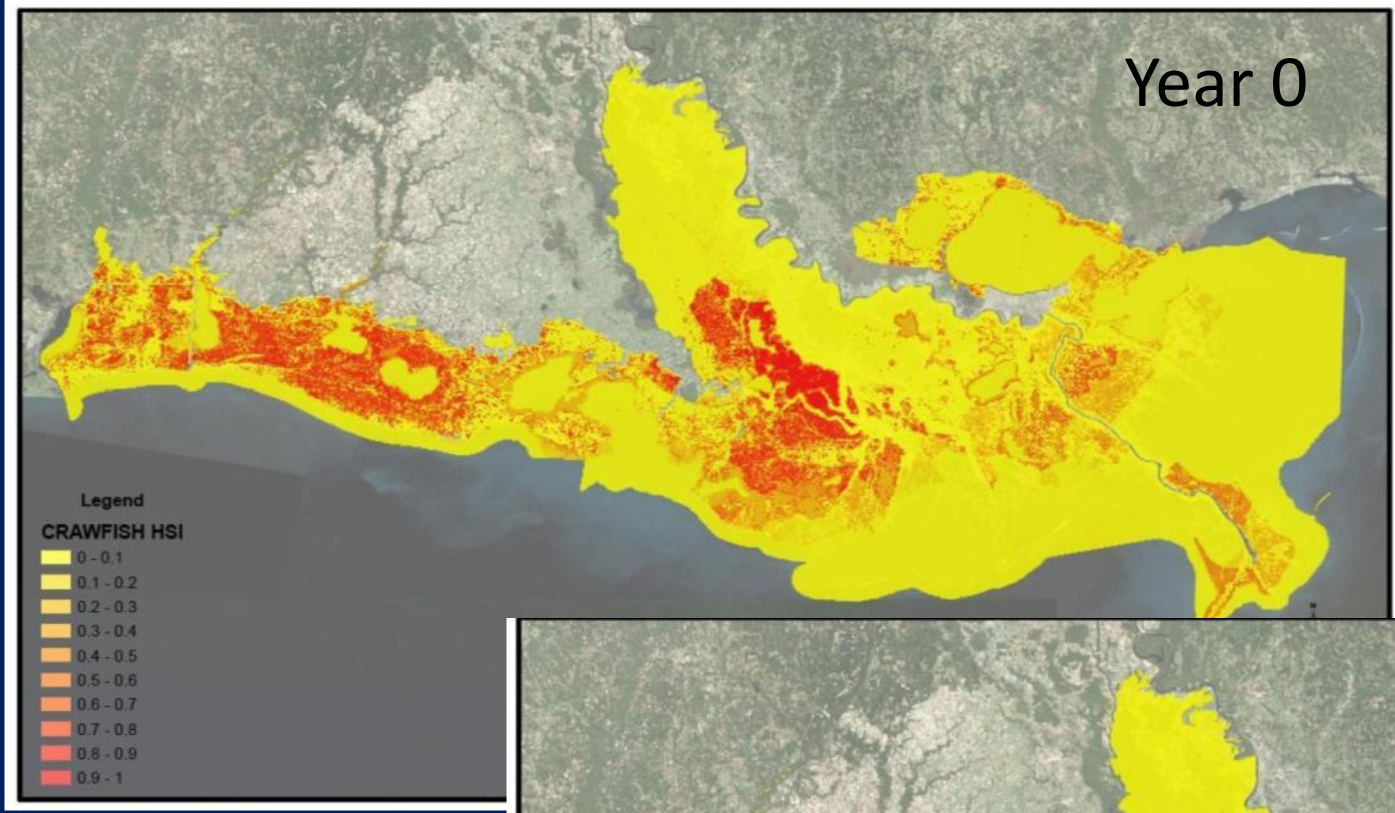
Ecosystem Service "Restoration Metrics"

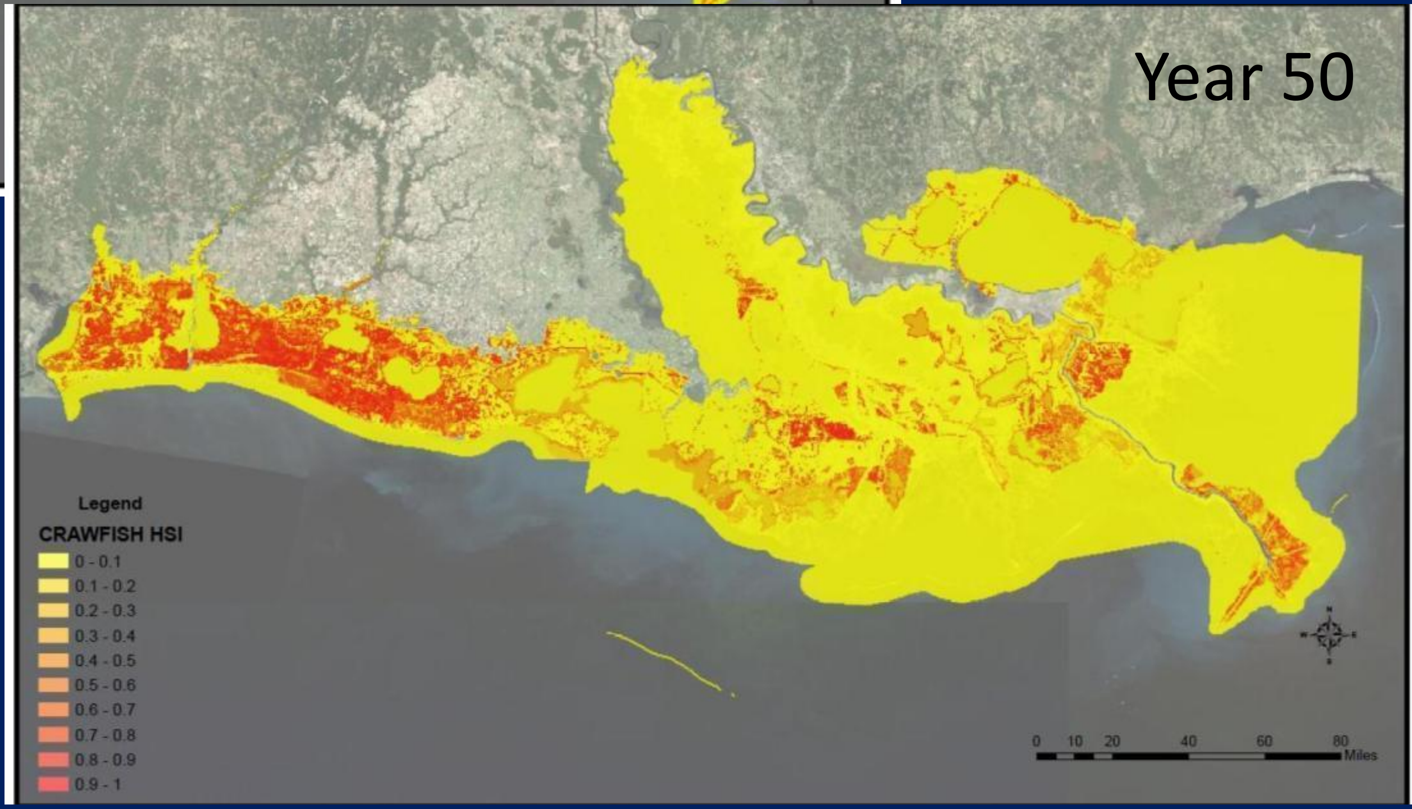
- Crawfish (wild caught)
- Alligator
- Oyster
- Shrimp (brown and white shrimp)
- Freshwater recreational fisheries (largemouth bass)
- Waterfowl (mottled duck, gadwall, green-wing teal)
- Saltwater recreational fisheries (spotted sea trout)
- Saltwater commercial fisheries (black drum)
- Existence of other characteristic fauna (roseate spoonbill, muskrat, otter)
- Agriculture / aquaculture
- Freshwater availability
- Surge / wave attenuation
- Nature based tourism
- Nitrogen removal
- Carbon sequestration

Crawfish

FWOA

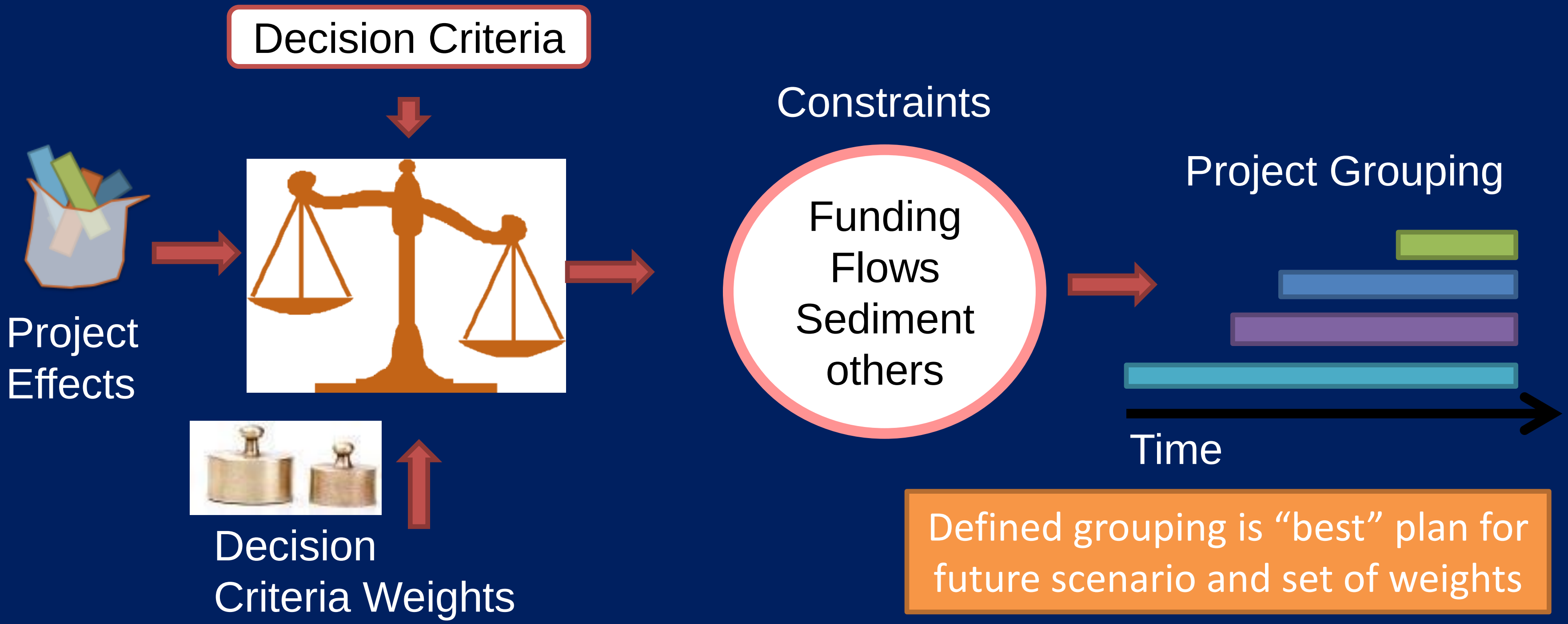
Scenario B





3) Construct feasible project groupings - alternatives

- Optimization algorithm determines which projects to implement and when subject to implementation constraints



Decision Criteria Reflect Broad Objectives

- Long-term progress towards risk reduction targets
- Time to risk reduction
- Flood protection of strategic assets
- Flood protection of cultural heritage sites

- *Use of natural processes*
- Persistence of ecosystem services
- Share of costs attributed to operations and maintenance (O&M)

- *Support of navigation*
- *Support of oil and gas*

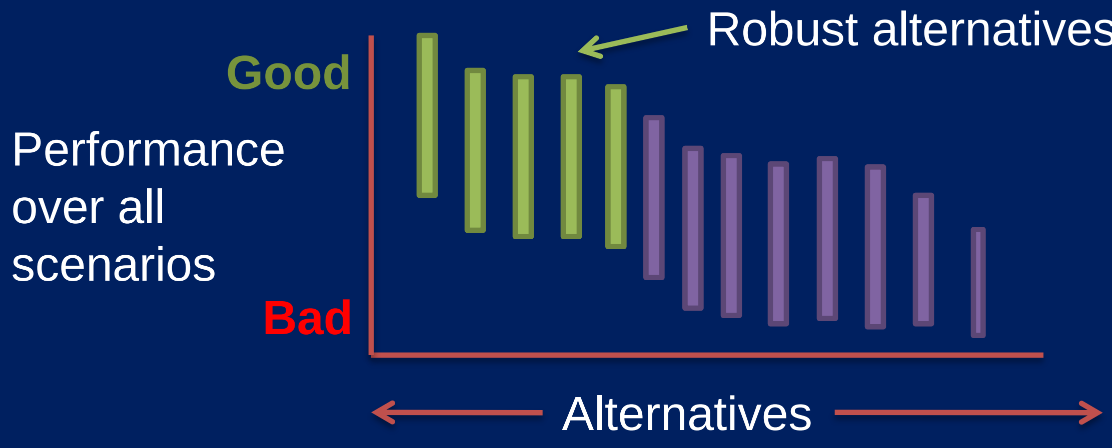
- Long-term progress towards ecosystem services targets (50-years)
- Near-term progress towards ecosystem services targets

- *Support of cultural heritage*
- *Percentage of population not requiring relocation*
- *Index of disproportionate impacts on socio-economic groups*

*Decision criteria are provisional

4) Select robust alternatives

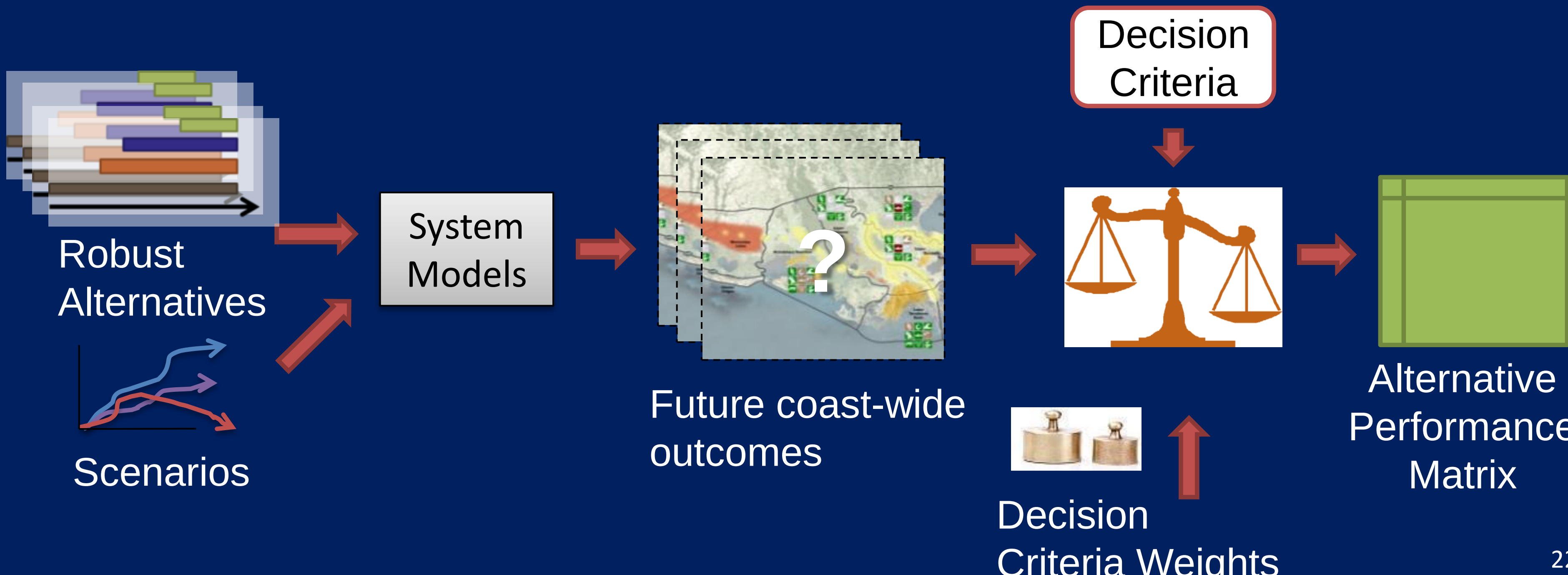
- Robustness analysis determines which alternatives perform well across most scenarios
- Steps to robustness analysis:
  1. Eliminate redundant alternatives
  2. Evaluate how each alternatives would perform under all scenarios (per decision criteria and weights)
  3. Graph range of performance for each alternative
  4. Select alternatives with high range of performance



Robust alternatives to be evaluated by Systems Models

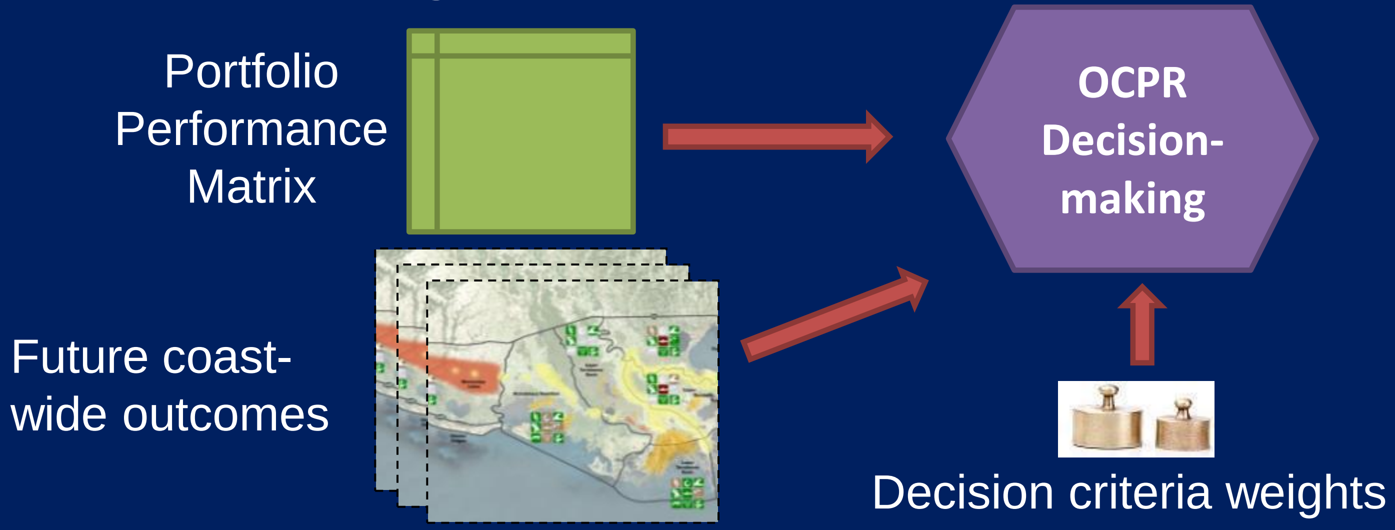
5) Estimate and compare alternatives' coast-wide effects

- System Models evaluation of alternatives accounts for project synergies/conflicts
- Reapplication of decision criteria and weights provide updated performance information



7) Consider trade-offs among robust alternatives

- How do robust alternatives perform?
- Re-application of robustness analysis:
  - Identifies dominant alternatives
  - Reveals common investments
  - Defines most robust option for different sets of decision criteria weights



2012 Master Plan Update

- A map showing projects and what they produce
- Implementation plan, including schedule, costs, and expected sources of funding
- An adaptive management plan to guide implementation

Coastal Protection and Restoration Authority of Louisiana

OFFICE OF Coastal Protection and Restoration

2012 Master Plan Update – Key Components

A planning process that:

- Uses desired outcomes to drive project selection
- Uses science based tools to evaluate projects
- Is transparent, objective and repeatable
- Sets the long-term course toward a future coast

What Doesn't it Do?

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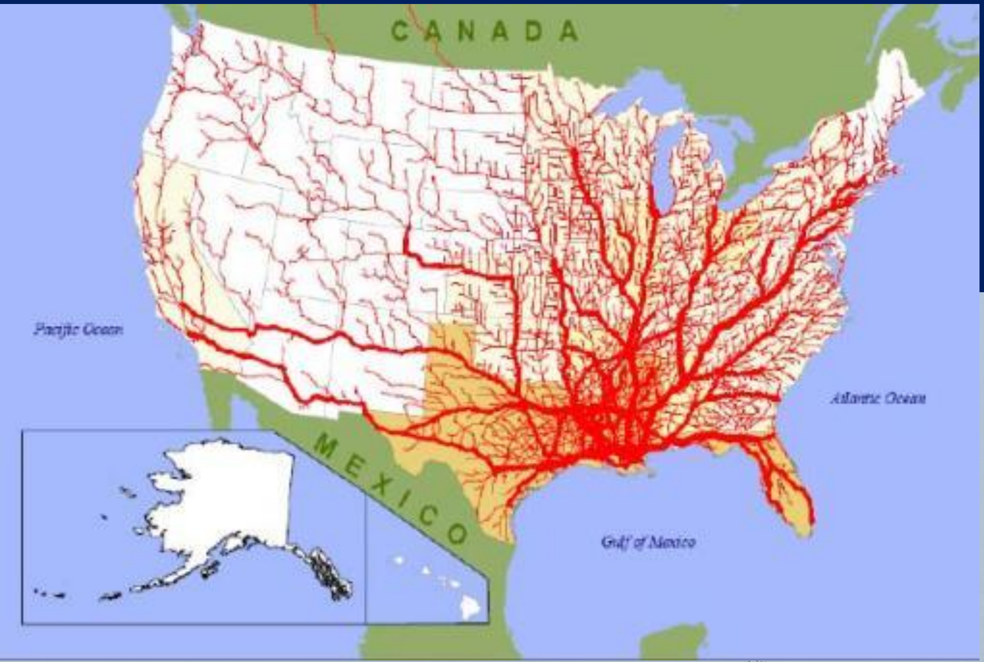
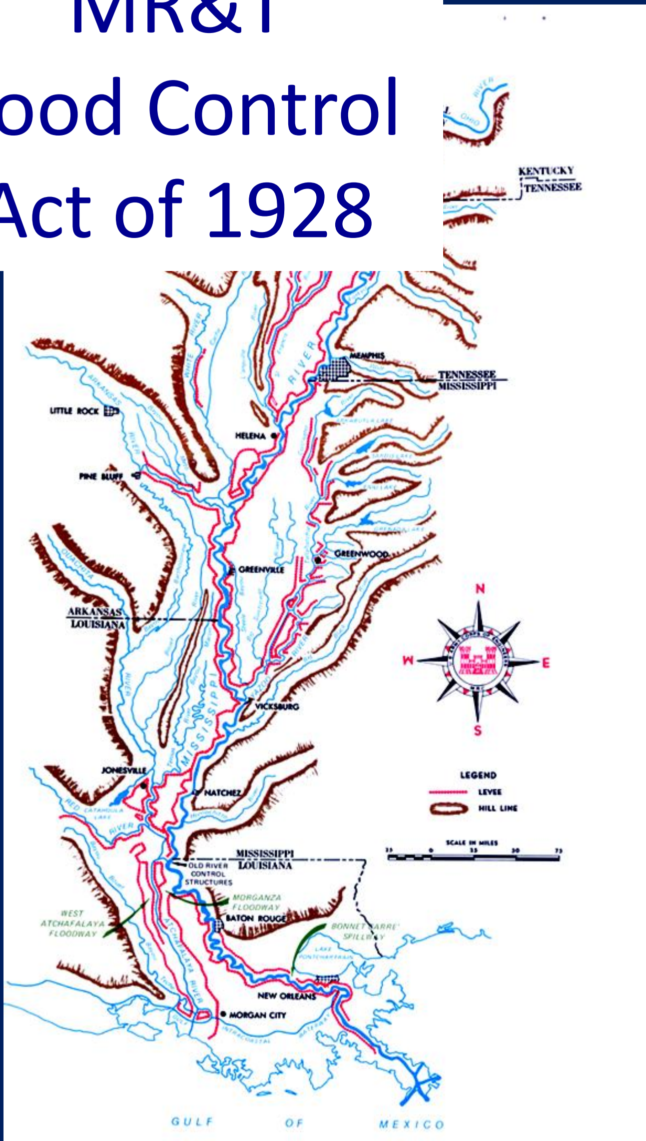
MR&T
Flood Control
Act of 1928






Questions?