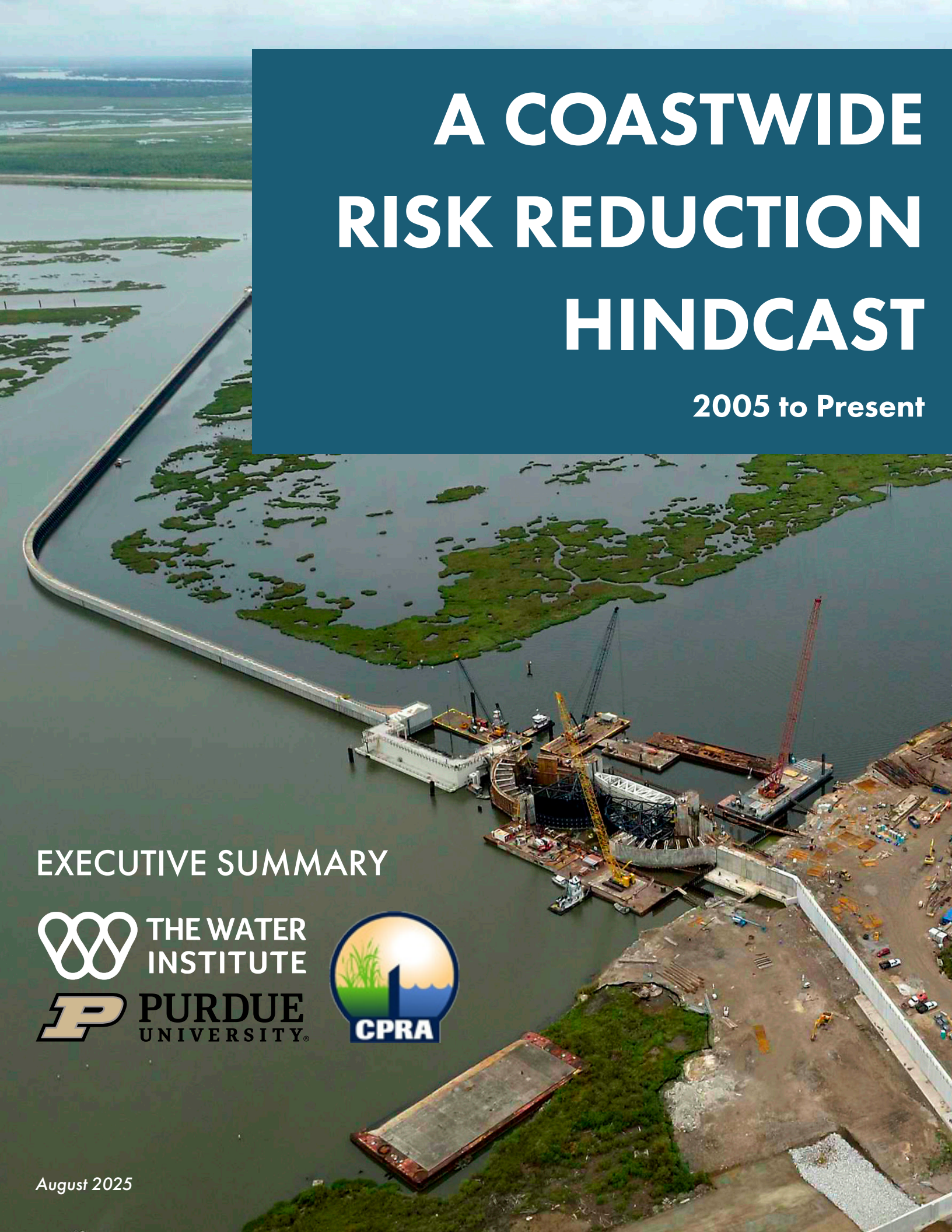
A COASTWIDE RISK REDUCTION HINDCAST

2005 to Present



EXECUTIVE SUMMARY

THE WATER INSTITUTE

PURDUE UNIVERSITY

CPRA

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INTRODUCTION

August 29, 2025 marks the 20th anniversary of the landfall of Hurricane Katrina. The storm surge and subsequent failures of levees and floodwalls led to the inundation of much of the Greater New Orleans and its surroundings, causing the loss of over 1,300 lives and approximately $166 billion in damage (2020 dollars). Together with Hurricane Rita, another large and intense storm that made landfall in southwest coastal Louisiana on September 22, the record-breaking 2005 hurricane season spurred the State of Louisiana to unify hurricane risk reduction and coastal restoration responsibilities under a new agency, the Coastal Protection and Restoration Authority (CPRA).

After Katrina, the U.S. Army Corps of Engineers (USACE), working in partnership with CPRA and local levee districts, redesigned and dramatically upgraded the system of levees, floodwalls, gates, and pumps surrounding both the East and West Bank of Greater New Orleans. This new system, termed the Greater New Orleans Hurricane and Storm Surge Risk Reduction System (HSDRRS), cost $18.2 billion (2020 dollars) to construct, a significant fraction of the approximately $21.2 billion spent on structural risk reduction by these entities since 2005 to help reduce flood risk from future tropical cyclones. The state invested an additional $3.2 billion on coastal restoration projects, which can also provide additional risk reduction benefits, during this period.

Grand Bayou Floodgate,
Photo: Louisiana Coastal Protection and Restoration Authority

Although pre-project benefit/cost comparisons were evaluated during the planning and decision-making phase, **there has not to date been a quantitative study to estimate the flood risk reduction benefits from the full range of structural risk reduction and ecosystem restoration investments made by CPRA and its partners to date.** In response to this need, CPRA asked The Water Institute and Purdue University (study team) to conduct a retrospective "hindcast" analysis using previously developed simulation models. This study is designed to better understand how the investments made since 2005 have reduced the impacts of flooding to Louisiana coastal communities in terms of flood extent, depth, and economic damage.

Gulf Intracoastal Waterway West Closure Complex,
Photo: Louisiana Coastal Protection and Restoration Authority

HURRICANE KATRINA REACHED THE COAST OF LOUISIANA ON AUGUST 29, 2005.

Photo: NASA/Goddard Space Flight Center Scientific Visualization Studio

APPROACH

For this hindcast analysis, the study team developed a new "what if" modeling scenario in which all flood risk reduction systems were set back to their pre-Katrina state and allowed to evolve in response to external drivers such as sea level rise and land subsidence from roughly 2005-2020, with no further investment in system repairs or improvements. This is termed the "No Investment" scenario. The study team compared this scenario to an "Existing Conditions" scenario originally developed for Louisiana's 2023 Coastal Master Plan, which instead includes all risk reduction and coastal restoration projects constructed from 2005-2020 in the modeled landscape. Both scenarios were evaluated against four recent historical storms—Katrina, Isaac, Laura, and Ida—as well as with a large ensemble of 645 "synthetic" storms with varying characteristics (e.g., storm track, minimum central pressure, size, etc.) that is designed to approximate the statistical likelihood of flooding and flood damage across the Louisiana coast.

Exploratory Case:

What if the investments made in Louisiana coastal restoration and risk reduction since 2005 never happened?

Research Objectives:

- Support CPRA efforts to determine how historical investments have reduced flood risk coastwide.
- Compare benefits and costs of investments from 2005-2020.

Research Questions:

- How might the New Orleans Hurricane & Storm Damage Risk Reduction System (HSDRRS) reduce risk from storms similar to historic storms?
- What is the overall risk reduction benefit from projects along the coast?

KEY TAKEAWAY

Twenty years after Hurricane Katrina, Louisiana can say with confidence and data:

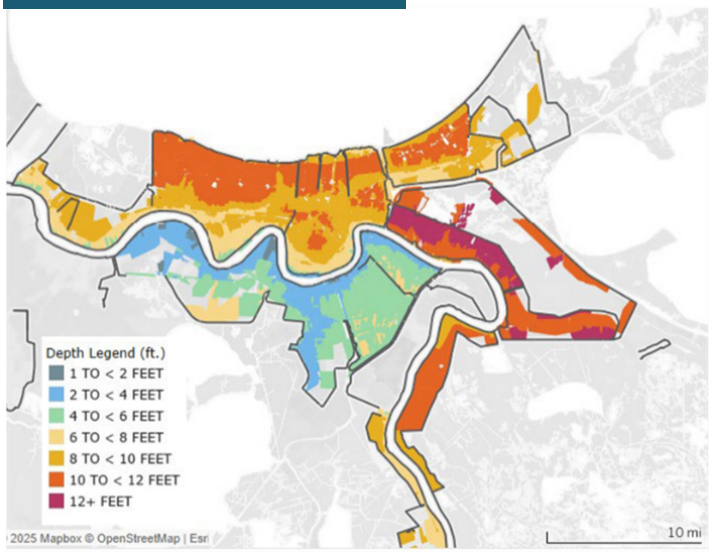
The investments made since 2005 are reducing risk and paying for themselves many times over.

Flood modeling results demonstrate dramatic reductions in both the spatial extent and depth of flooding under Existing Conditions when compared to the No Investment scenario in Greater New Orleans. Hurricane Isaac, for example, made landfall as a major surge-and rain-producing event in 2012 against a mostly complete HSDRRS system. This storm could have caused tens to hundreds of billions of dollars in flood damage to East and West Bank assets within an unimproved No Investment system, especially if levees and floodwalls were to catastrophically fail as occurred during Katrina (Figure ES 1).

Instead, flood damage within the HSDRRS system both during the actual 2012 event and in the Existing Conditions simulation was minimal, yielding risk reduction benefits from this single storm of up to $165 billion (2020 dollars). In turn, this suggests the HSDRRS investment paid for itself just from the system's successful performance during this single hurricane event. When looking across a statistical ensemble of synthetic storm events, moreover, this analysis estimates annual damage reduction benefits from HSDRRS of $6.1 to $7.8 billion per year (2020 dollars), yielding benefit-cost ratios between 4:1 and 10:1.

Although the majority of investment to date in dollar terms has been focused on the areas of Greater New Orleans within HSDRRS, this analysis also shows that the $3 billion investment in upgraded or new structural risk reduction systems outside of HSDRRS in Plaquemines, Lafourche, and Terrebonne parishes, as well as other coastal communities, have also yielded substantial damage reduction. Coastwide, expected annual damage under Existing Conditions is approximately 60% less than under the No Investment hindcast, and risk reduction investments outside of HSDRRS have yielded benefit-cost ratios of between 4:1 to 8:1.

No Investment



Existing Conditions

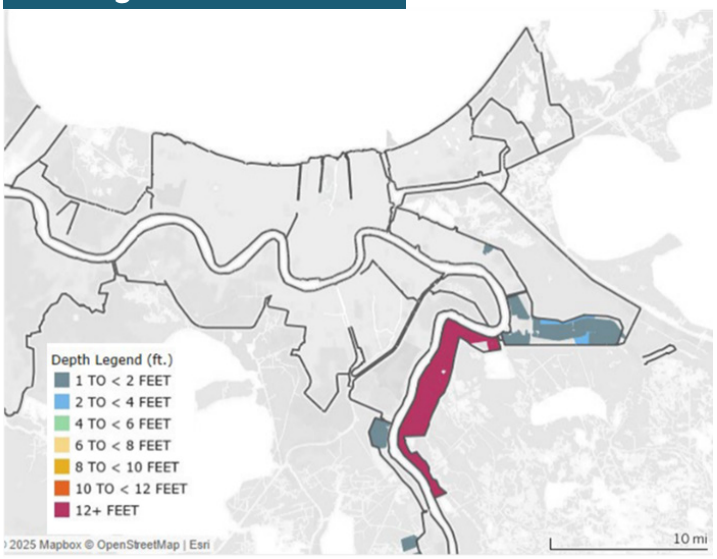


Figure ES 1. Simulated peak flood depths from an Isaac-like event under the No Investment and Existing Conditions scenarios in Greater New Orleans. No Investment includes the possibility of levee breaching, while Existing Conditions assumes flooding from overtopping and rainfall only, consistent with the historical experience during Hurricane Isaac within the HSDRRS system.

Mississippi River,
Photo: Harold Stiver/Adobe Stock

CONCLUSION

This analysis provides strong supporting evidence for the benefits of Louisiana's ongoing coastal risk reduction investments. Combined with separate modeling to support Louisiana's 2023 Coastal Master Plan, this study suggests that such large-scale risk reduction investments are achievable and justified economically.

Major flood protection infrastructure failures like what occurred during Hurricane Katrina make headlines and drive policy change, but when infrastructure works as intended, the benefits are often hidden or are seen as unremarkable. Research studies like this one that use hindcast models to capture alternative past scenarios can help bring to light the success of past infrastructure investments and lay the groundwork for the next generation of projects. As Louisiana marks the somber 20th anniversary of Hurricane Katrina, the state and federal governments should also mark the successes that followed through these substantial coastal improvements.