THE ROAD TO RESILIENCY:

A PROACTIVE APPROACH TO CREATING CLIMATE-RESILIENT WATER INFRASTRUCTURE

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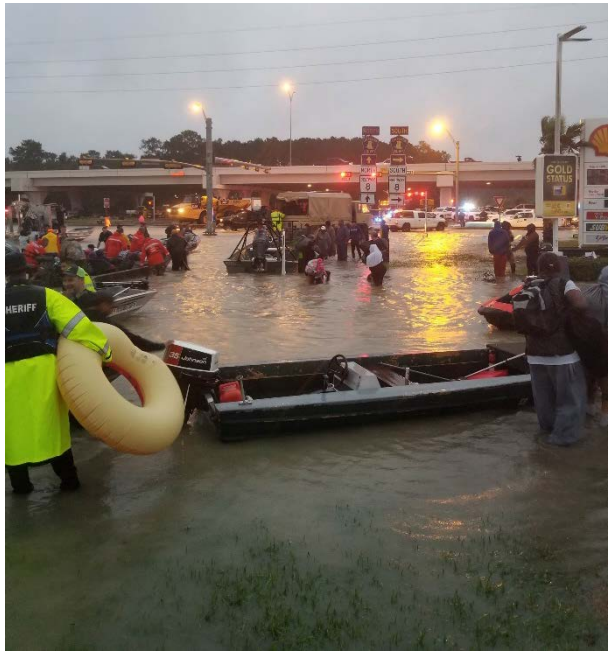
THE RISKS OF SEA LEVEL RISE (SLR) ARE REAL

- With a price tag upwards of $200 billion, 2017 hurricane season was the most expensive in U.S. history.

- “Towns and cities in Florida and Texas are still waiting for hundreds of millions of dollars in promised reimbursement.”

(Source: Bloomberg News, 6/4/18)



Houston, TX, Hurricane Harvey, 2017

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THE RISKS OF SEA LEVEL RISE (SLR) ARE REAL

"The brutal 2017 season was an awful reminder of the huge hurricane vulnerability problem we face, and how unprepared we are for a potential future where the strongest storms get stronger and push their storm surges inland on top of steadily rising sea level."

-- Weather Underground Meteorologist Jeff Masters

Ruptured 48-inch raw water main during Hurricane Matthew, 2016, Brunswick County, NC

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WHAT IS PROJECTED FOR FLORIDA?

Source: Unified Sea Level Rise Projection-Southeast Florida; Southeast Florida Regional Compact Climate Change October 2015.

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PROJECTED IMPACTS OF PROJECTED SLR/STORM SURGE IN FLORIDA

- Cities at or below 4 ft of high tide inundated by 100-year storm 2030.
- By 2050 100-year storm projected to be the 5-year storm.
- 15 of the 20 largest population centers in Florida are located below this elevation.

Source: “What Will Adaptation Cost? An Economic Framework for Coastal Community Infrastructure” June 2013 Eastern Research Group, Inc. Written under contract for the National Oceanic and Atmospheric Administration (NOAA)

City of Daytona Beach, Hurricane Matthew, 2016

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WHAT IS PROJECTED FOR COASTAL TEXAS?

Source: Unified Climate Central Texas and the Surging Sea December 2014.

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PROJECTED IMPACTS OF PROJECTED SLR/STORM SURGE FOR COASTAL TEXAS

- Cities at or below 5 ft of high tide inundated by 100-year storm 2030.
- By 2050 , today's 100-year storm projected to be 5-year storm.
- More than 1000 square miles of land in Texas lie below 5' of the current high tide elevation.
- 4 Power plants and 254 listed EPA sites lie below this elevation.

Source: Unified Climate Central Texas and the Surging Sea December 2014

Houston, Hurricane Harvey, 2017

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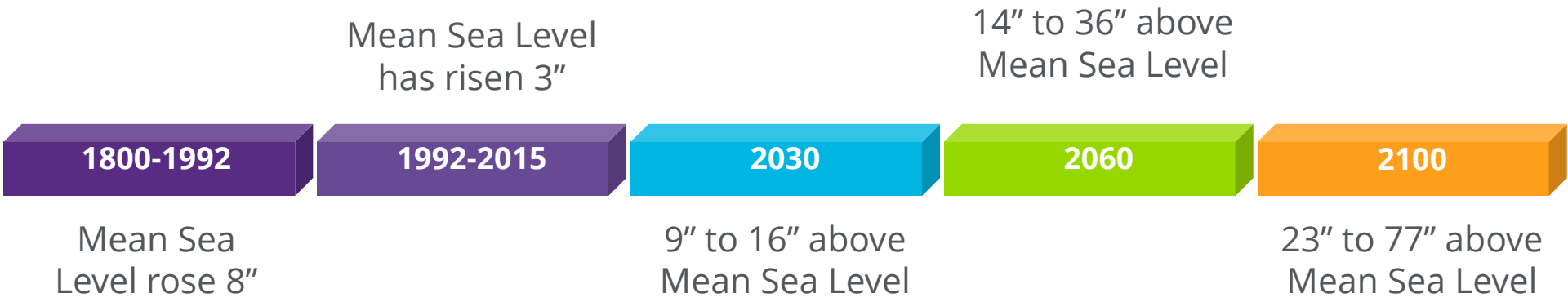
WHAT IS PROJECTED FOR COASTAL NORTH CAROLINA?



Source: NOAA Technical Report NOS CO-OPS 083 (2017), intended for the 2018 U.S. National Climate Assessment

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PROJECTED IMPACTS OF PROJECTED SLR/STORM SURGE IN NORTH CAROLINA

- By the year 2100 the projection for coastal North Carolina is for a sea level rise of between 1.7 to 6.2 feet.
- A sea level rise of six feet would put all of North Carolina's coastal cities in jeopardy of being flooded.
- Today's 100-year (1%) flooding event may be, on average, a yearly event by approximately year 2055.

Wilmington, NC, Record-breaking rainfall, 2018

Sources: researchmatters.noaa.gov/news/Pages/sealevels.aspx
sealevel.climatecentral.org
www.yaleclimateconnections.org

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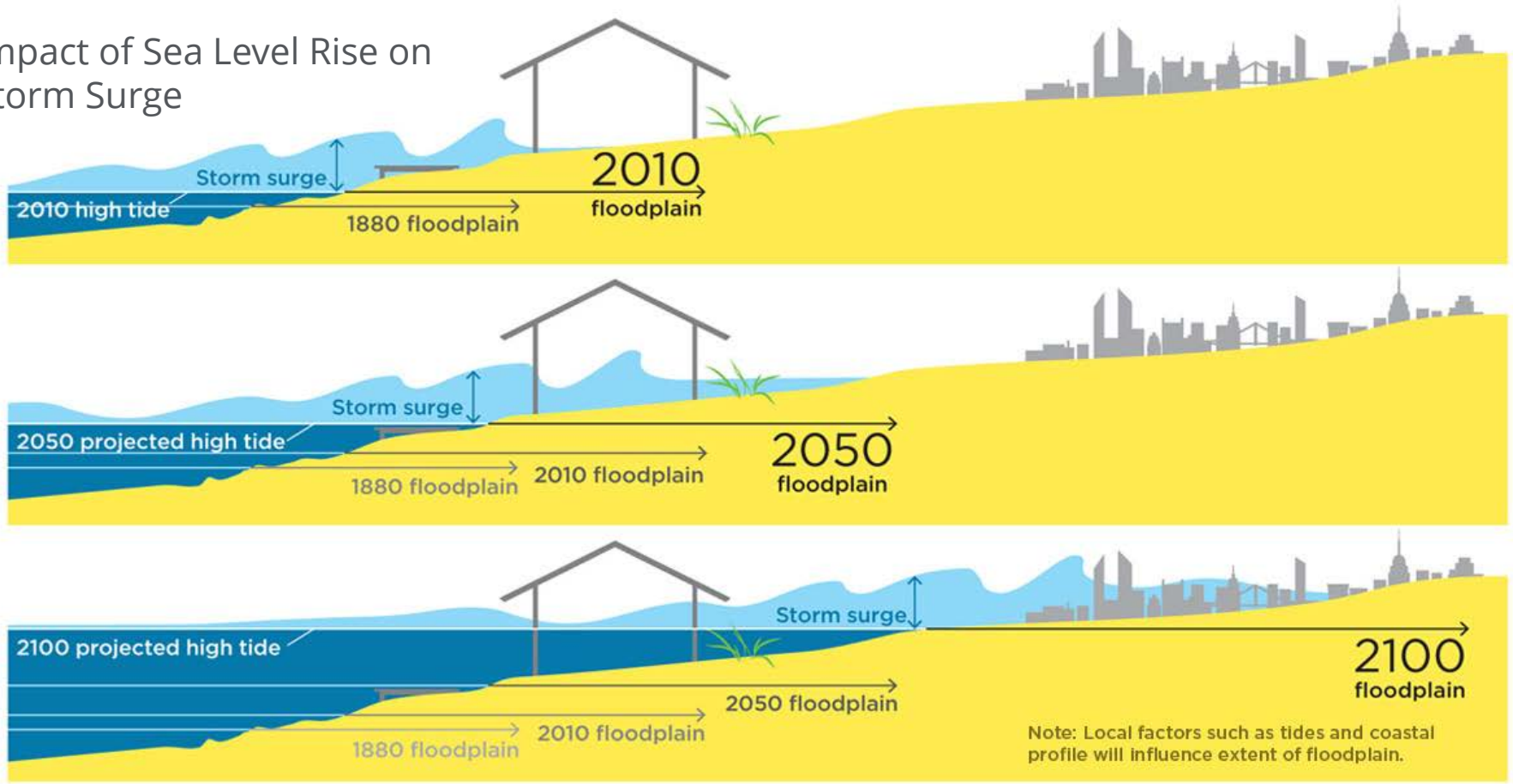
Impact of Sea Level Rise on Storm Surge



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ON THE ROAD TO RESILIENCY, WHERE ARE YOU NOW?

Assess risk.

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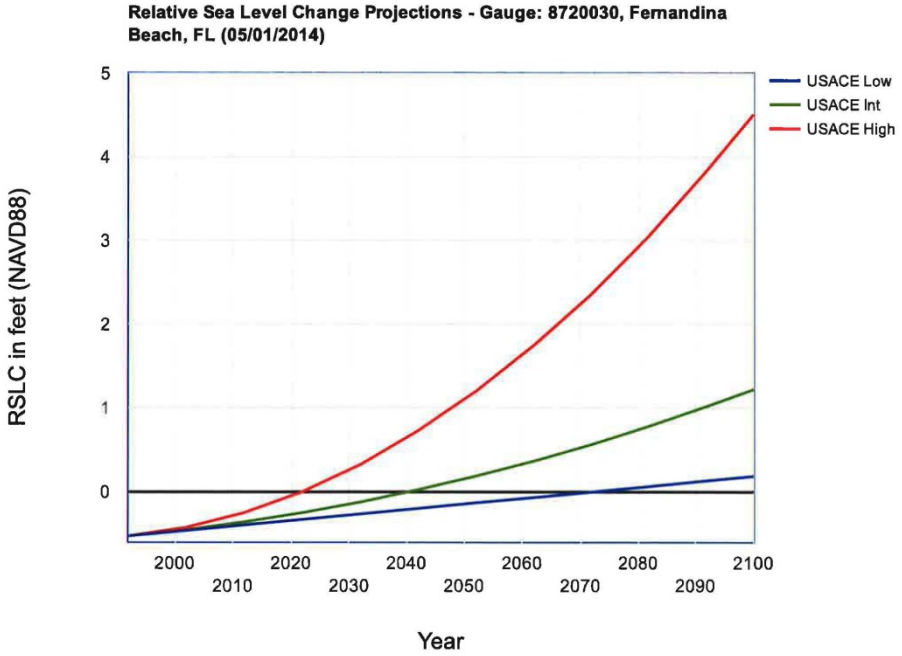
1. USE APPROPRIATE NOAA PROJECTED SLR CURVE

- For high-risk infrastructure, use high projection for future SLR.
- For low-risk infrastructure, the low projection for future SLR can be used.



Graphic Relative Sea Level Change (RSLC) Scenarios for Fernandina Beach, FL, as calculated using NOAA projections and regional corrections. (USACE, 2015) Source: NOAA August 2015

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2. DETERMINE SERVICE LIFE OF THE FACILITY

- Service life used to determine length of SLR evaluation.

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3. DETERMINE EVENT TO BE EVALUATED

- Determine risk profile.
- Determine overall system vulnerability.
  - Is the facility evaluated being set to meet a higher standard than more critical equipment in the overall system?

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4. OVERLAY GIS/SURVEY DATA OF SITE ON SAME DATUM

- Collect/process data.
  - Static scan
  - Drone survey
  - Conventional survey
- Synchronize datums.
- Create surface.

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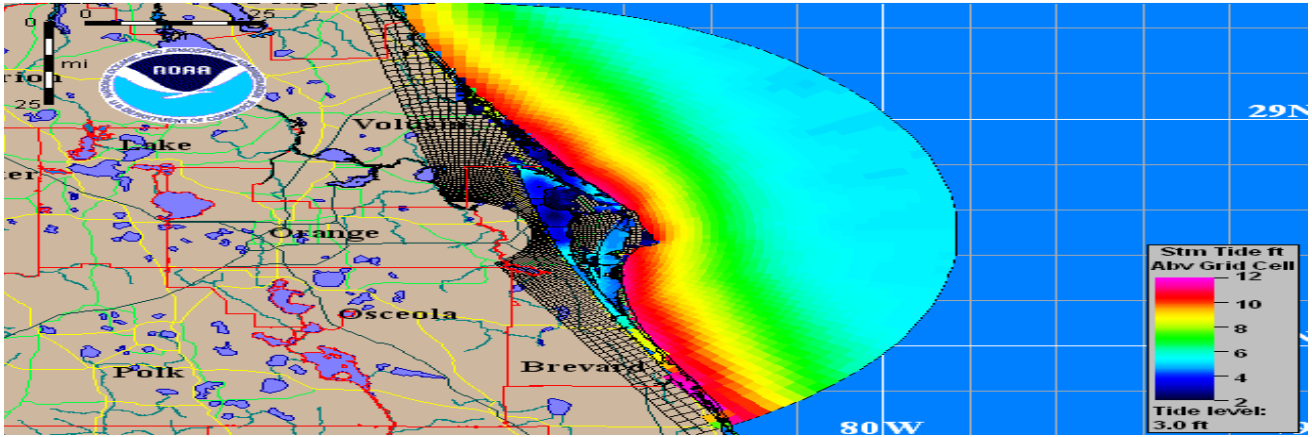
5. DETERMINE FLOODING ELEVATION

- Utilize projected SLR for year/curve evaluated.
- Utilize existing NOAA storm surge maps for event evaluated.
- Project flood elevation for facility/event evaluated.



Maximum water depth, Category 3 hurricane hitting at high tide

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6. ANALYZE PROJECTED IMPACT

- Compare surge/flooding elevation to elevation of critical facility components.
- Monetize impact.

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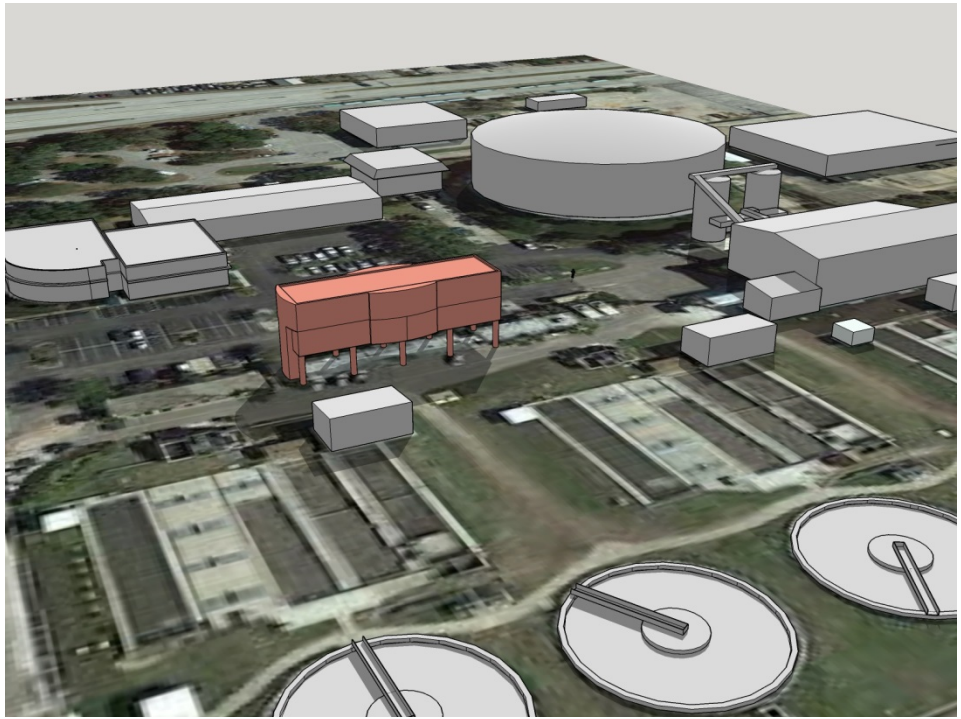
EXAMPLE: BEFORE



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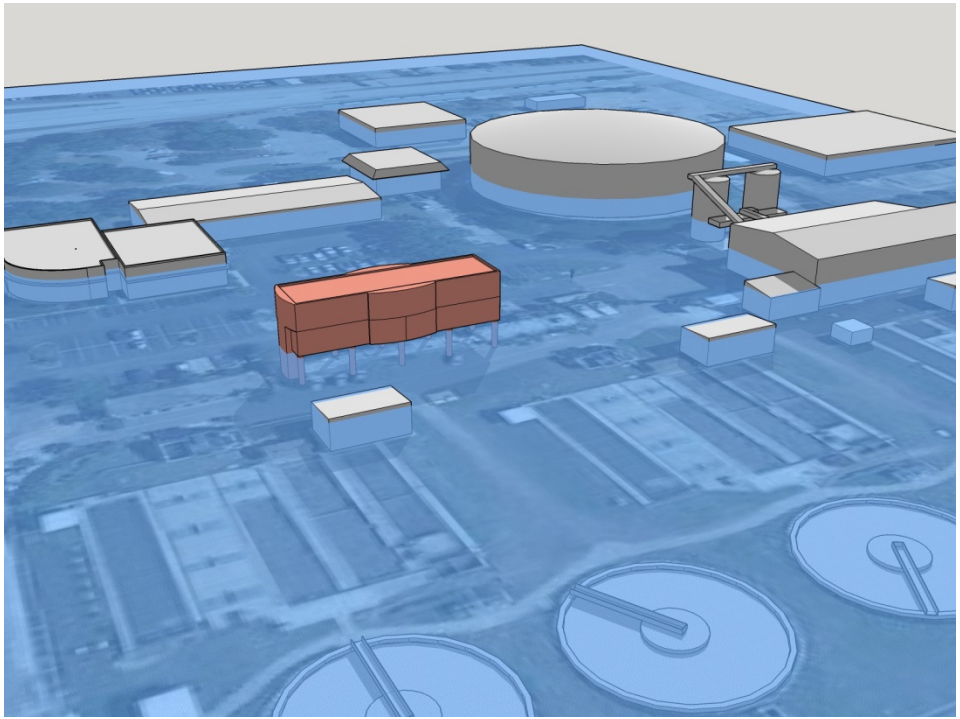
EXAMPLE: AFTER



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ON THE ROAD TO RESILIENCY, WHERE DO YOU WANT TO GO?

Consider solutions.

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1. ELEVATE/RELOCATE INFRASTRUCTURE

2. HARDEN FACILITIES

- Waterproof equipment.
  - Wet-proof/dry-proof structures
- Utilize submersible equipment.
- Utilize temporary flood barriers.
  - Deployables
- Utilize adequate emergency pumping systems.
- Utilize permanent barriers.
  - Earthen berm
  - Flood wall
  - Elevated roadway
  - Elevated landscaping/planters

Flood Barriers

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3. FACILITATE RESTORATION

- Modular equipment
- Redundant facilities
- Bypass capabilities
- Emergency power

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ON THE ROAD TO RESILIENCY, HOW WILL YOU GET THERE?

Research funding sources.

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CAN A UTILITY AFFORD NOT TO BECOME RESILIENT?

It is estimated that **EVERY $1 SPENT**

on pre-disaster mitigation/hardening measures

results in a post-event recovery and replacement

SAVINGS OF BETWEEN $4 AND $36.*

*"Disaster Mitigation is Cost Effective", Ilan Kelman, Cicero Norway, World Development Report 2014

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BARRIERS TO ENACTING DISASTER RISK REDUCTION SAVINGS

- If it's not visible and tangible, it can be more difficult to get buy-in from stakeholders.
- Post-disaster aid can produce much more political capital than less visible long-term mitigation measures.
- Necessary to complete disaster recovery work, mitigation work is often not seen as the highest and best use of limited utility funds.

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GRANTS

- EPA Smart Growth Grants
- Partnership for Sustainable Communities (EPA/HUD/DOT)
- FEMA HAZARD Mitigation Grant (Florida Division of Emergency Management)
- USDA Conservation Innovation Grant
- Federal Funding Compendium for Urban Heat Adaptation

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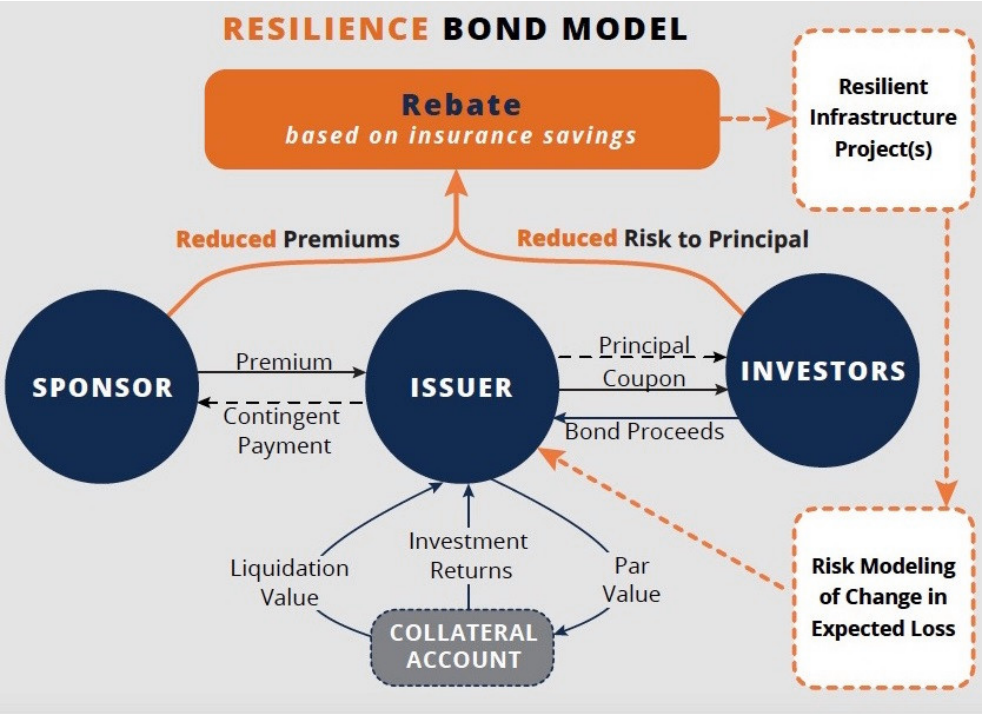
RESILIENCE BONDS



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BUDGET RESILIENCE IMPROVEMENTS

- Plan, design and budget resilience measures into new infrastructure designs.
- Plan, design and budget resilience measures into rehab/retrofit projects.
- Funding is included in overall project budget in C.I.P.
- Resilience measures can be funded through loans:
  - FDEP CWSRF
  - FDEP DWSRF

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