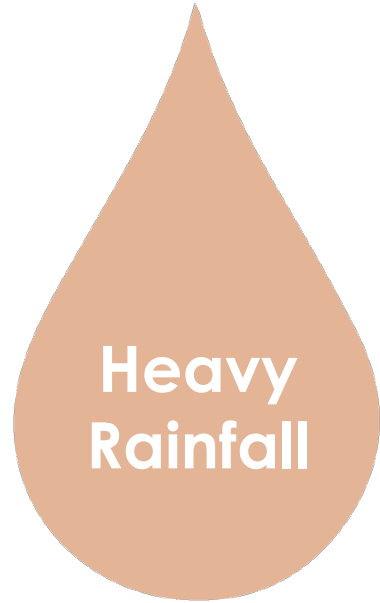


Florida Flood Risks

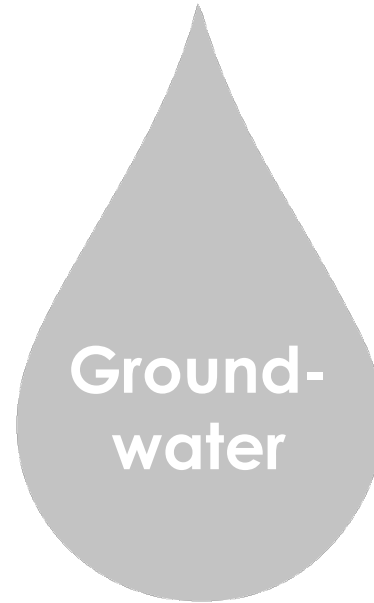


Heavy
Rainfall

Runoff/Riverine



Storm
Surge



Ground-
water



Tidal
Flooding

"King Tides"



Sawgrass Mills Mall

Sunrise, Florida



Silva Harapetian
@silvaharapetian

[Follow](#)

Sawgrass Mills Mall: parking lot is not caving in. "The car is actually parked in a 'drainage swale'...driver trying to exit didn't see..."

7:16 PM - Jun 6, 2017

2 15 13



Sawgrass Mills
@ShopSawgrass

[Follow](#)

Due to area flooding, Sawgrass Mills will be closed today, June 7, 2017. We will continue to assess the situation throughout the day.

8:01 AM - Jun 7, 2017

2 53 32



- 15" of rain in 3 days, with most in 24 hours.
- Mall closed for 3 days due to flooding.
- Approximately \$4 million in lost revenue per day (based on company-wide numbers).

Punta Gorda Seawall Failures

Punta Gorda, Florida

- Water retreated due to offshore hurricanes winds.
- Seawalls overloaded and collapsed.
- Important component of stormwater system for coastal cities.



Images from City of Punta Gorda website.

St. John's River Flooding during Irma

Jacksonville, Florida

Rainfall (5-10") + storm surge

 **NWS Jacksonville** 
@NWSJacksonville

Storm Surge Flooding exceeds all-time record in downtown Jacksonville record set in Hurricane Dora in 1964.
[#jaxwxwater.weather.gov/ahps2/hydrogra...](#)

4:42 AM - Sep 11, 2017

10 487 261

JACKSONVILLE

Jacksonville proposes buying out flood-prone homes in South Shores

Residents say tidal flooding gets worse every year

By Jenese Harris - Reporter/anchor
Posted: 5:55 PM, November 06, 2017
Updated: 6:39 PM, November 06, 2017

News4JAX.com

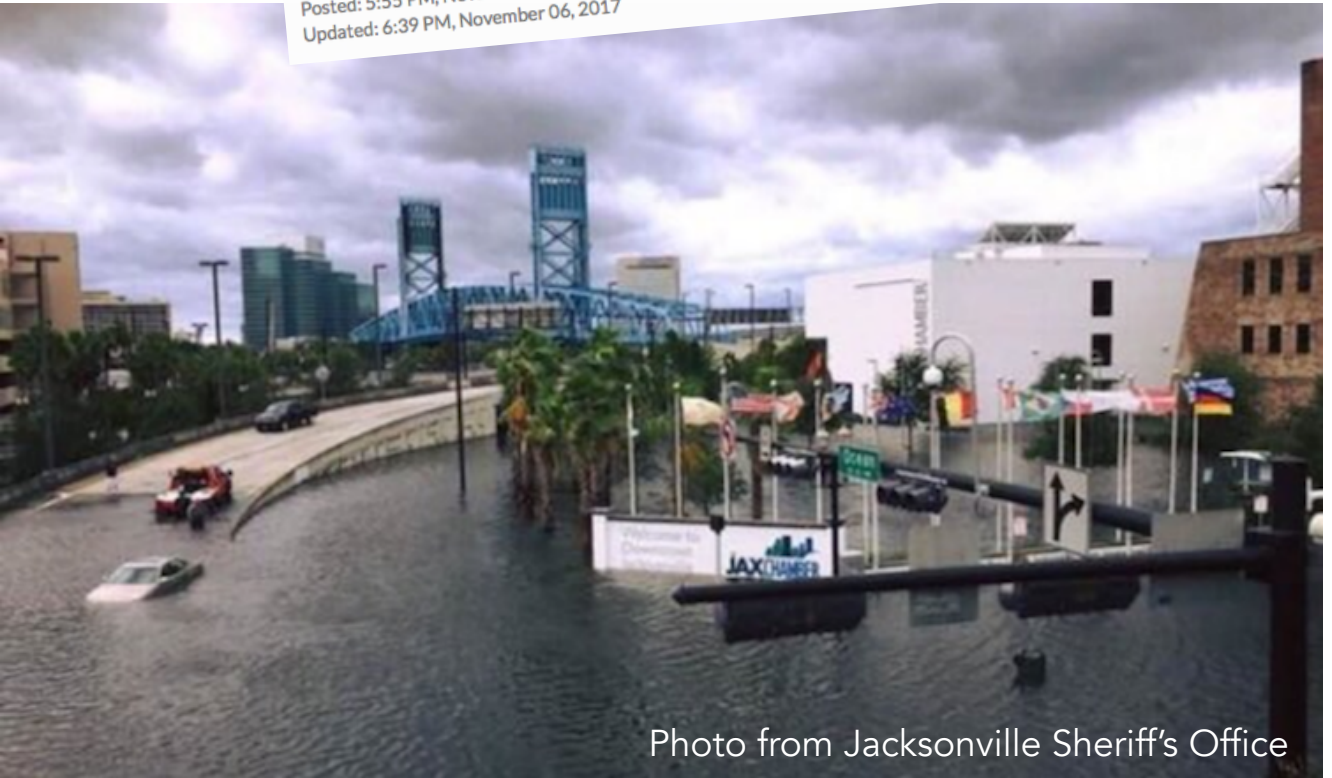
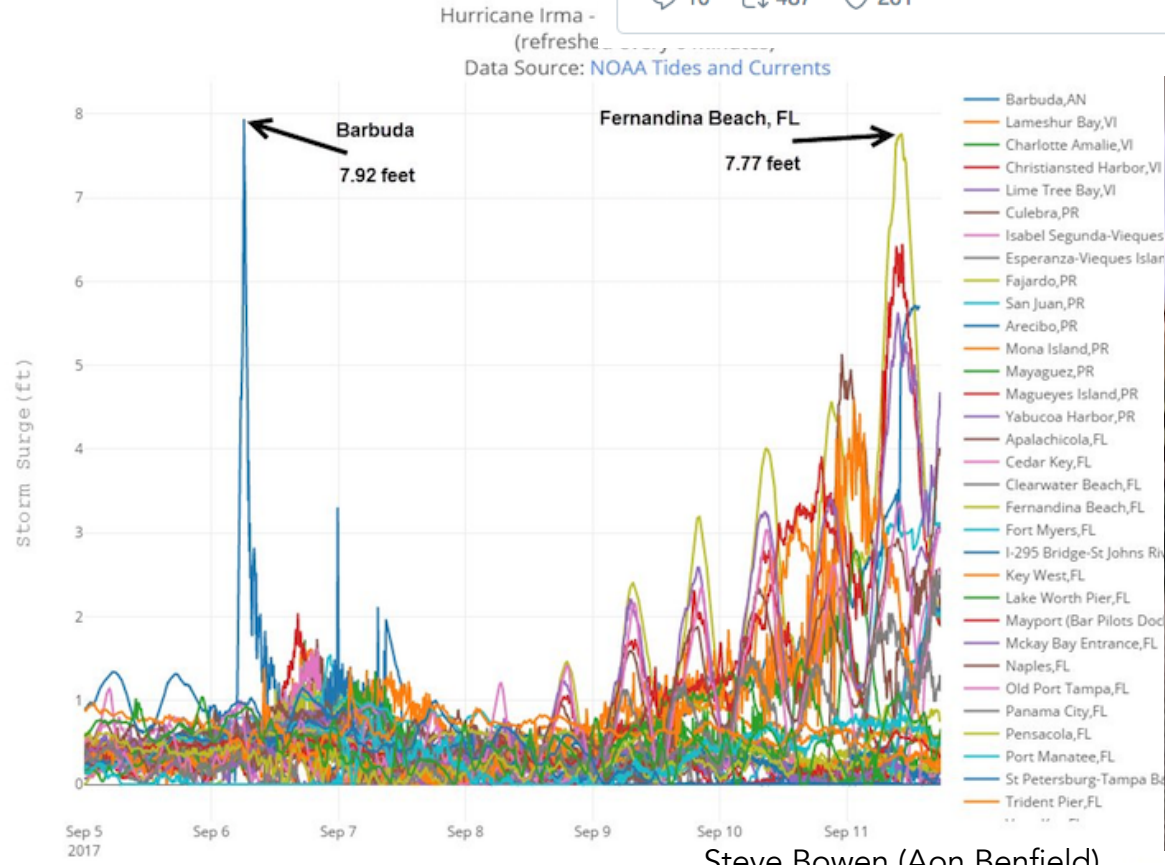
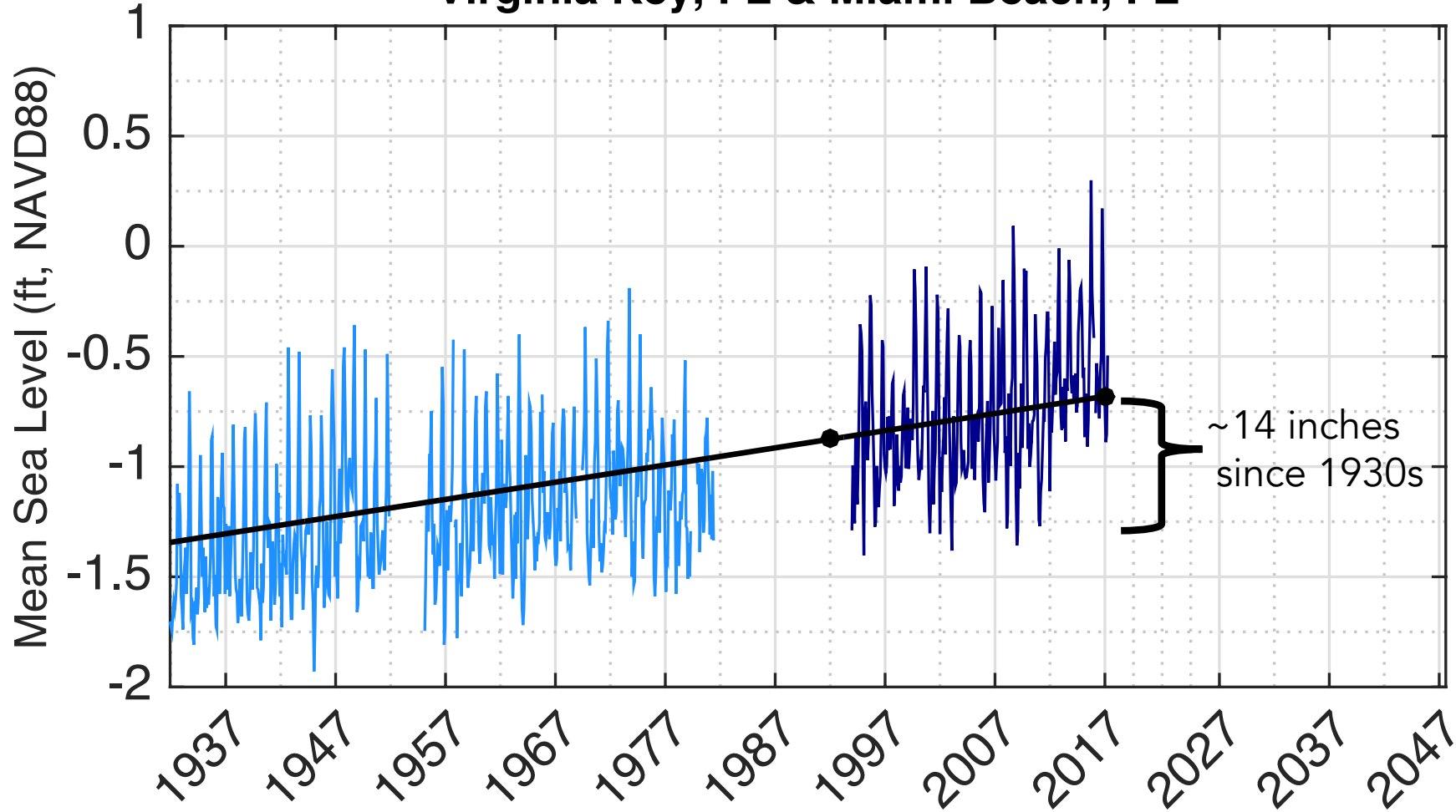


Photo from Jacksonville Sheriff's Office

Rising Seas have and will continue to create greater challenges for communities dealing with flooding events.

**Historic Mean Sea Level (MSL) & Projections
Virginia Key, FL & Miami Beach, FL**

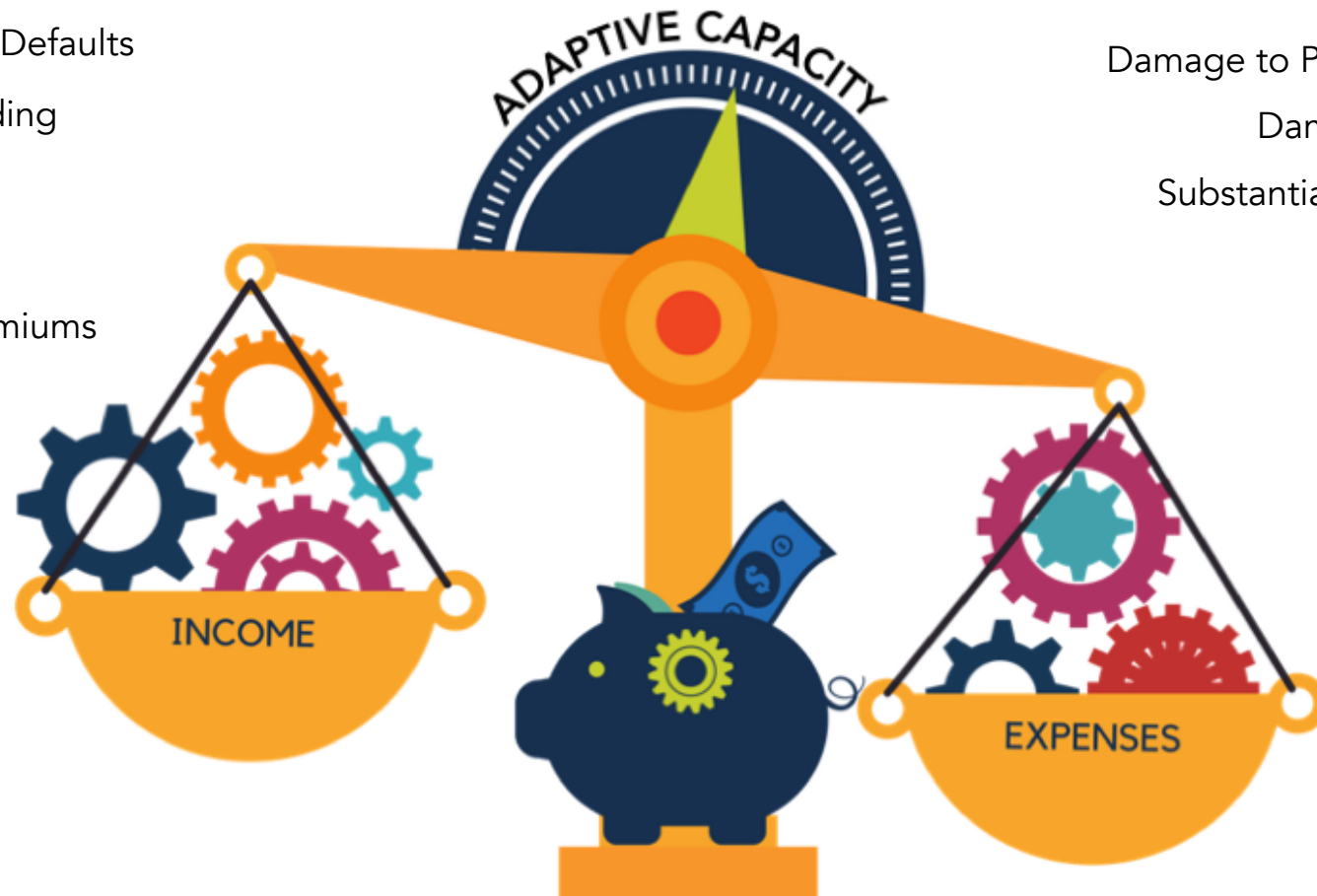


The Catch-22 of Sea Level Rise

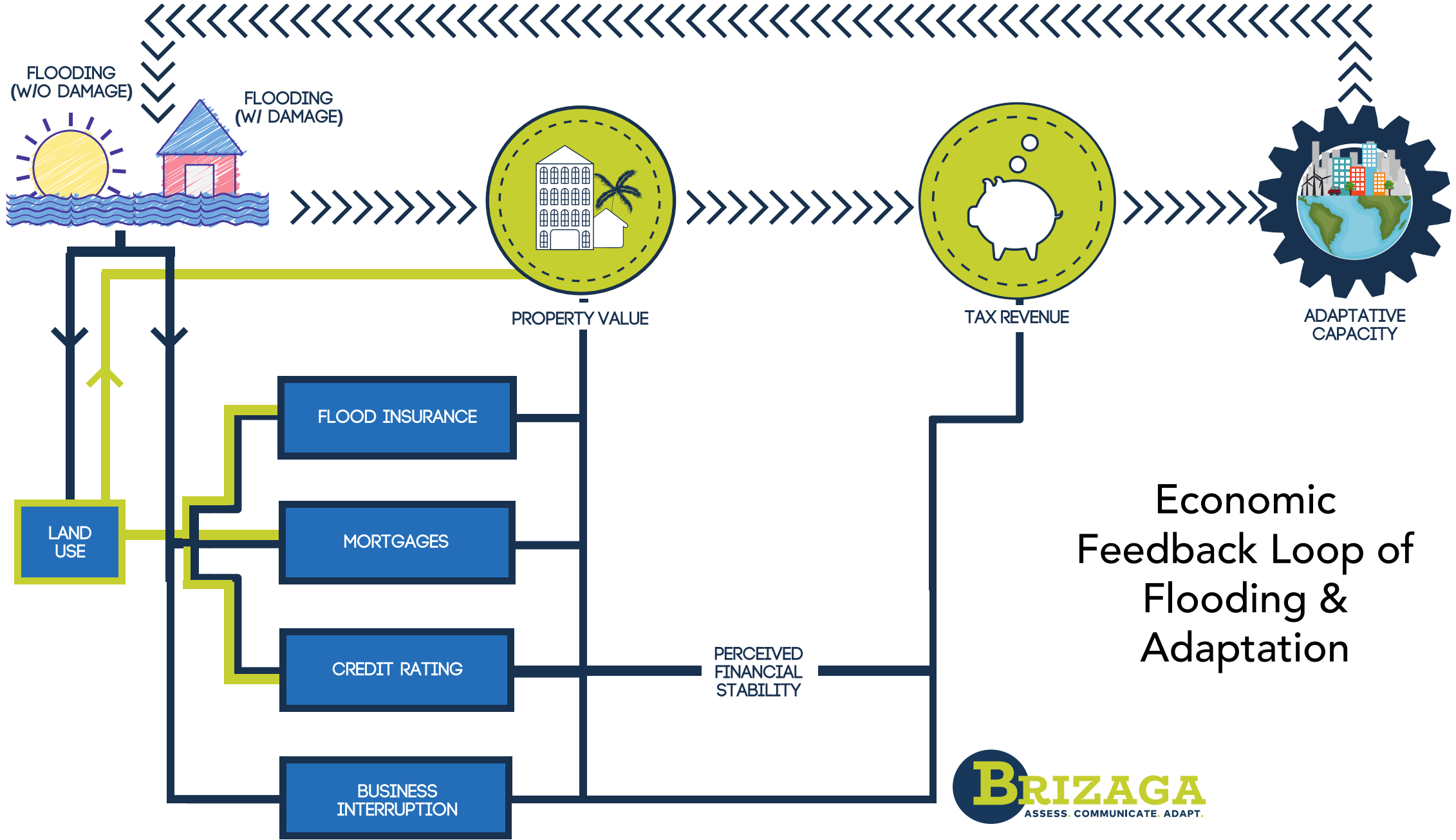
Those communities that will require the most investment to adapt will also be hit the hardest financially by sea level rise.

- Potential Increases in Mortgage Defaults
- Business Interruption from Flooding
- Reduction in Tourism
- Municipal Bond Ratings
- Changes in Flood Insurance Premiums
- Migration of Residents

- Damage to Public Assets & Infrastructure
- Damage from Extreme Weather
- Substantial Investments in Adaptation
- Greater Public Health Costs



ADAPTATION JOURNEY



Economic
Feedback Loop of
Flooding &
Adaptation

Municipal Bonds

- Adaptation today (bonding projects today) will make it easier to bond projects in the future.
- Communities that wait to adapt may find it harder to bond public infrastructure projects.



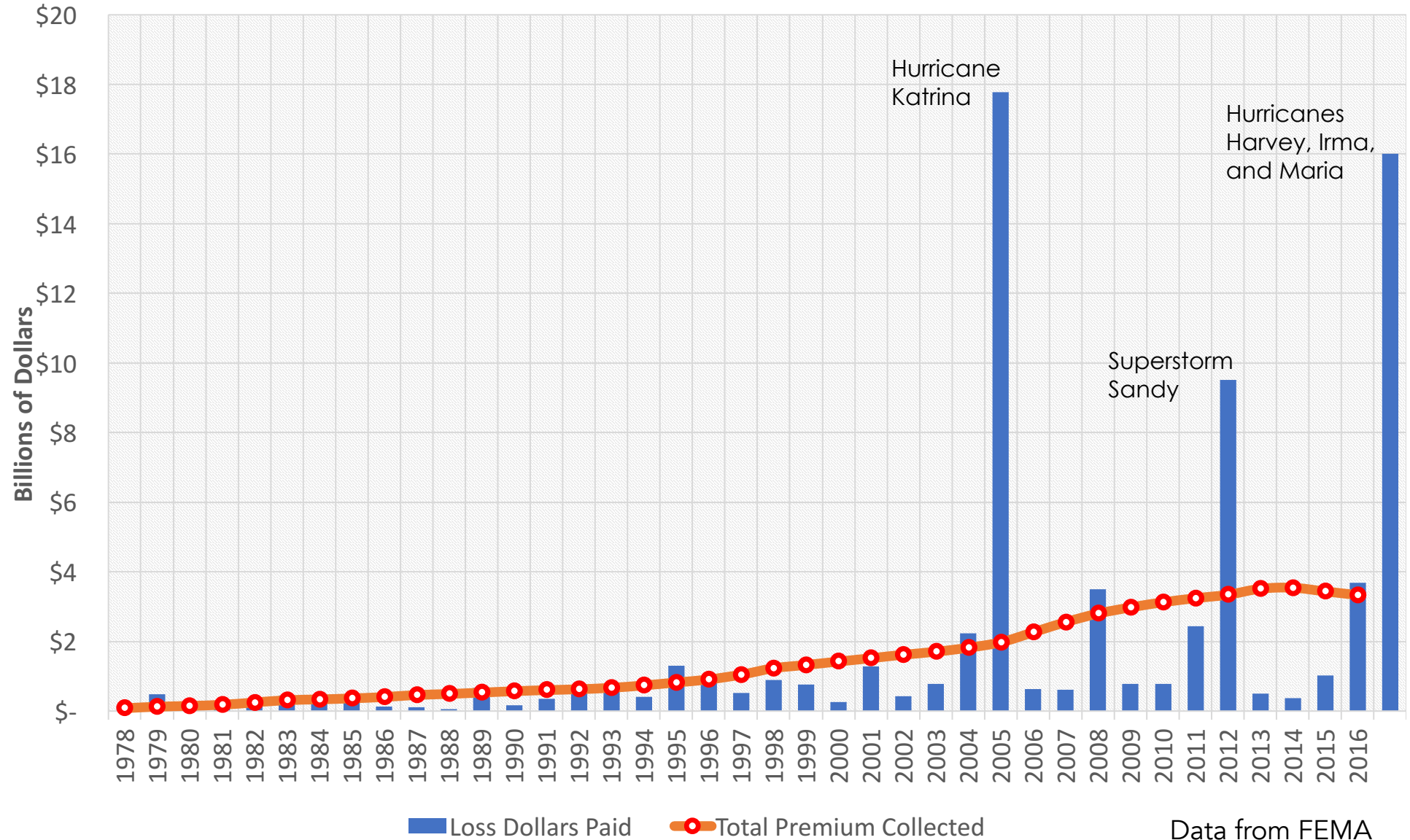
Flood Insurance

National Flood Insurance Program (NFIP)

Federal Emergency Management Agency (FEMA)

What is the future of the private flood insurance market?

Housing affordability (+ potential for less offerings of 30-year mortgages).



Data from FEMA

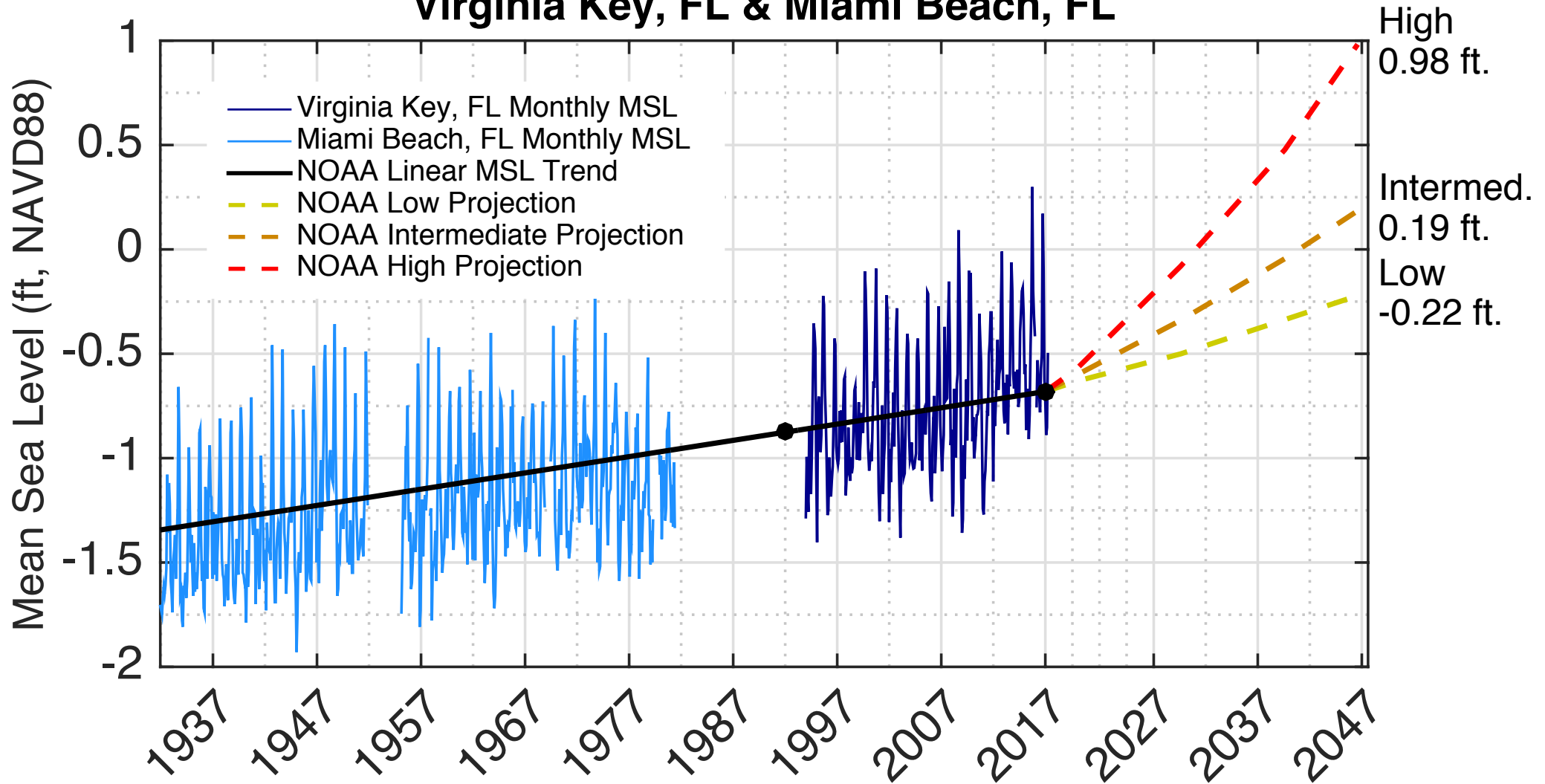


Even the
biggest bucket
can be filled
drop by drop.

EXTRA SLIDES

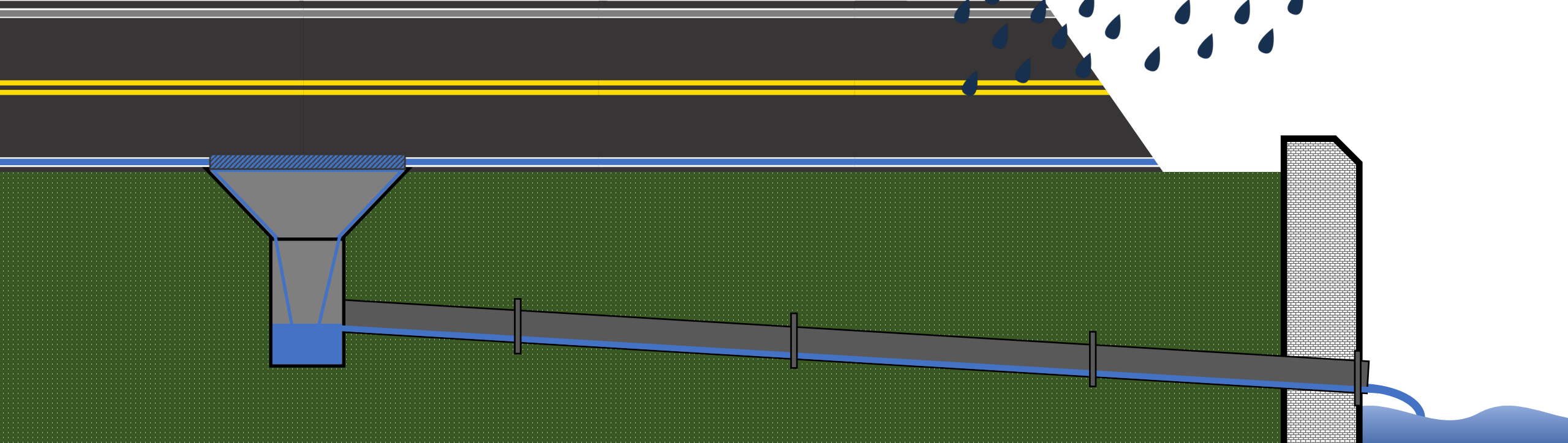
What does the **future** look like?

Historic Mean Sea Level (MSL) & Projections Virginia Key, FL & Miami Beach, FL

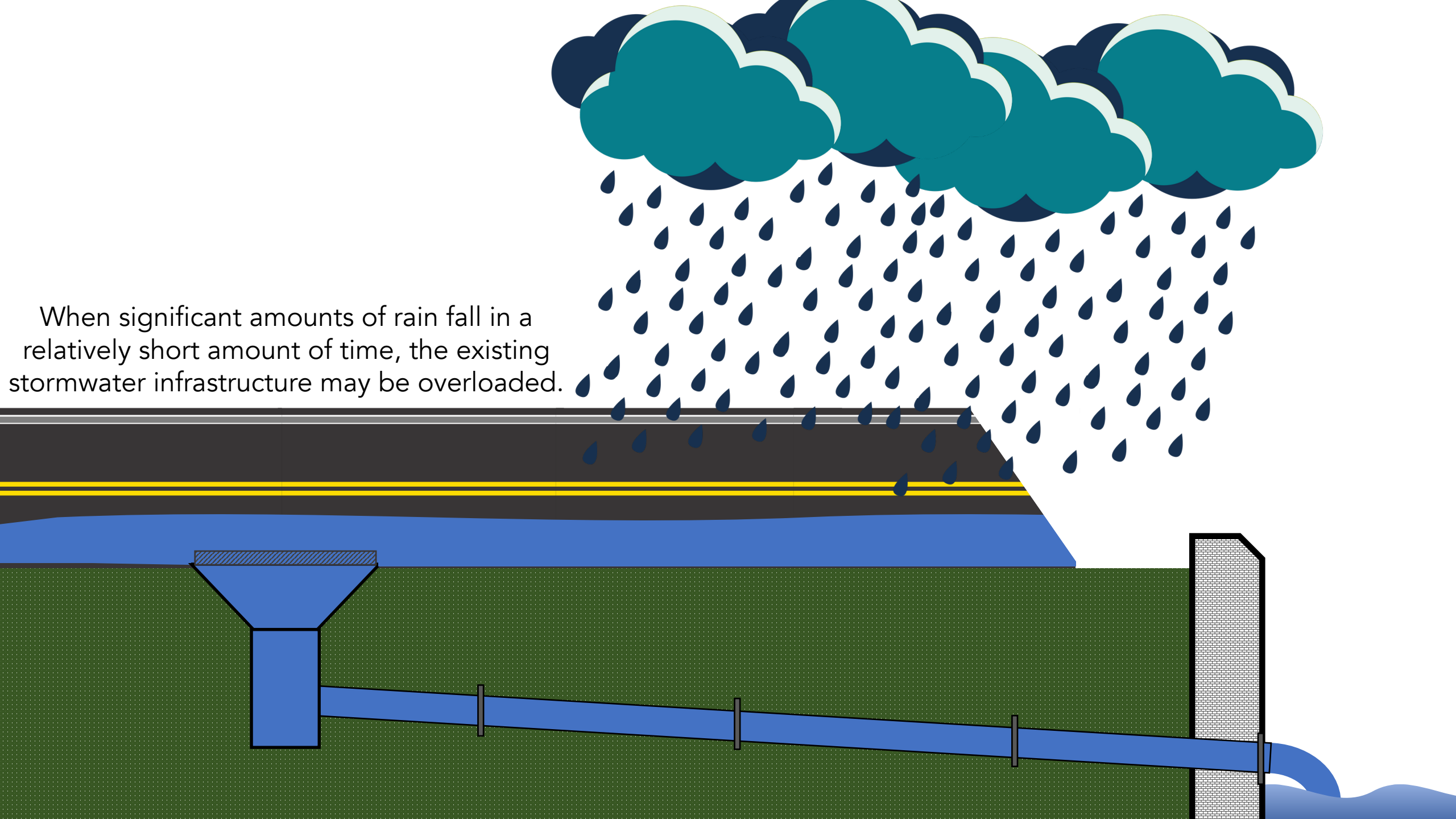




In coastal communities, our stormwater systems use gravity to move water from the our streets out to sea.

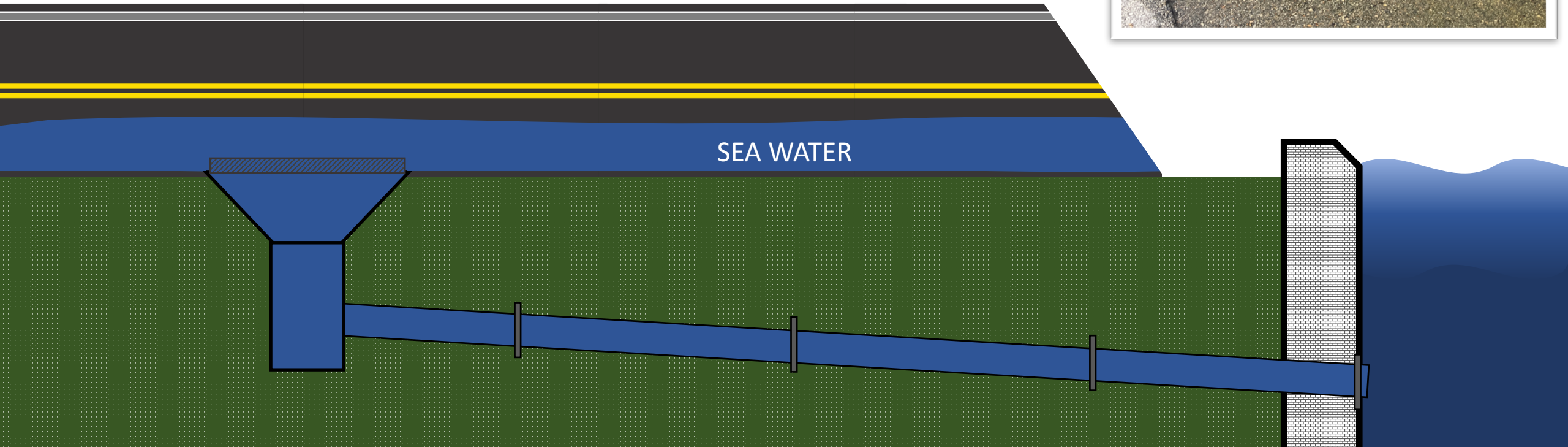


When significant amounts of rain fall in a relatively short amount of time, the existing stormwater infrastructure may be overloaded.

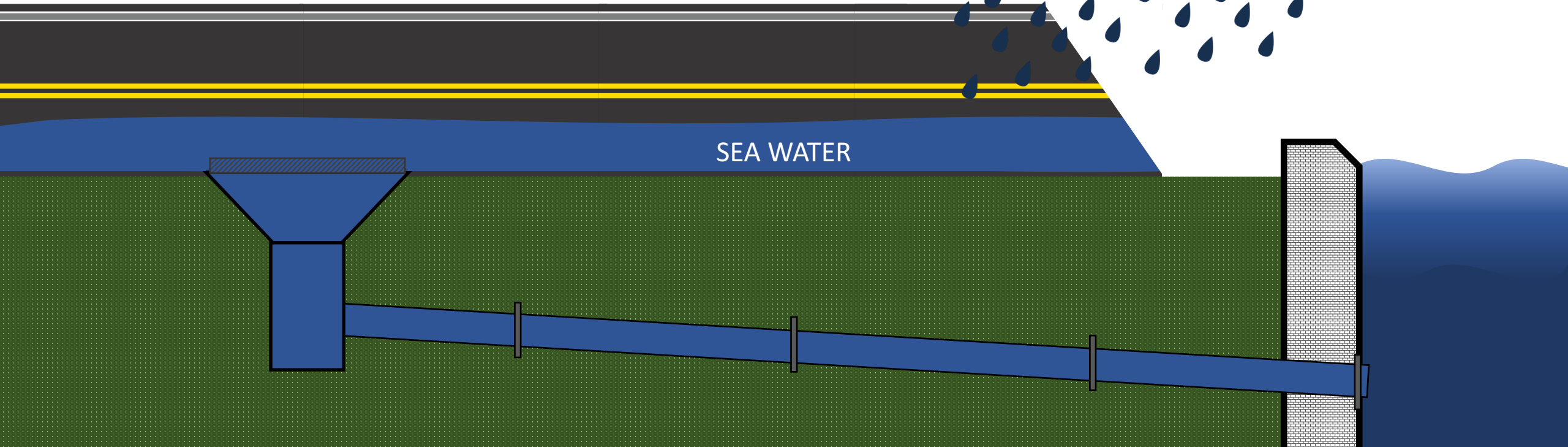




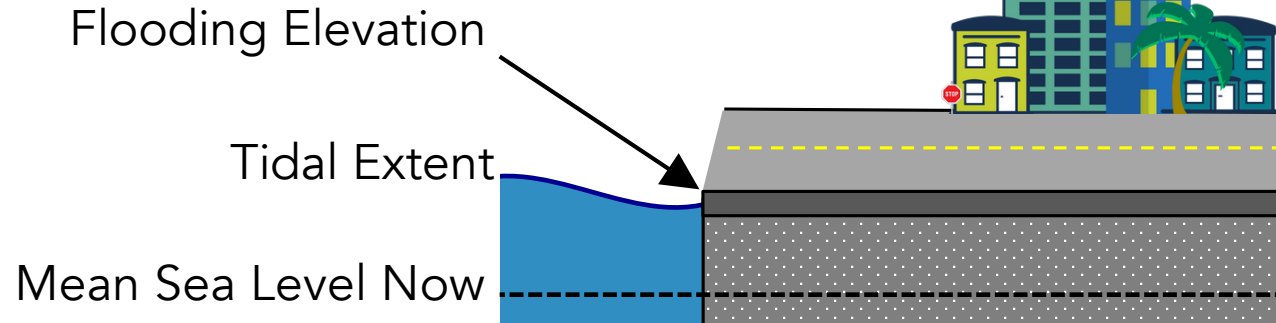
Our stormwater systems become conduits for sea water.
Sunny Day Tidal Flooding or Fair-Weather Flooding



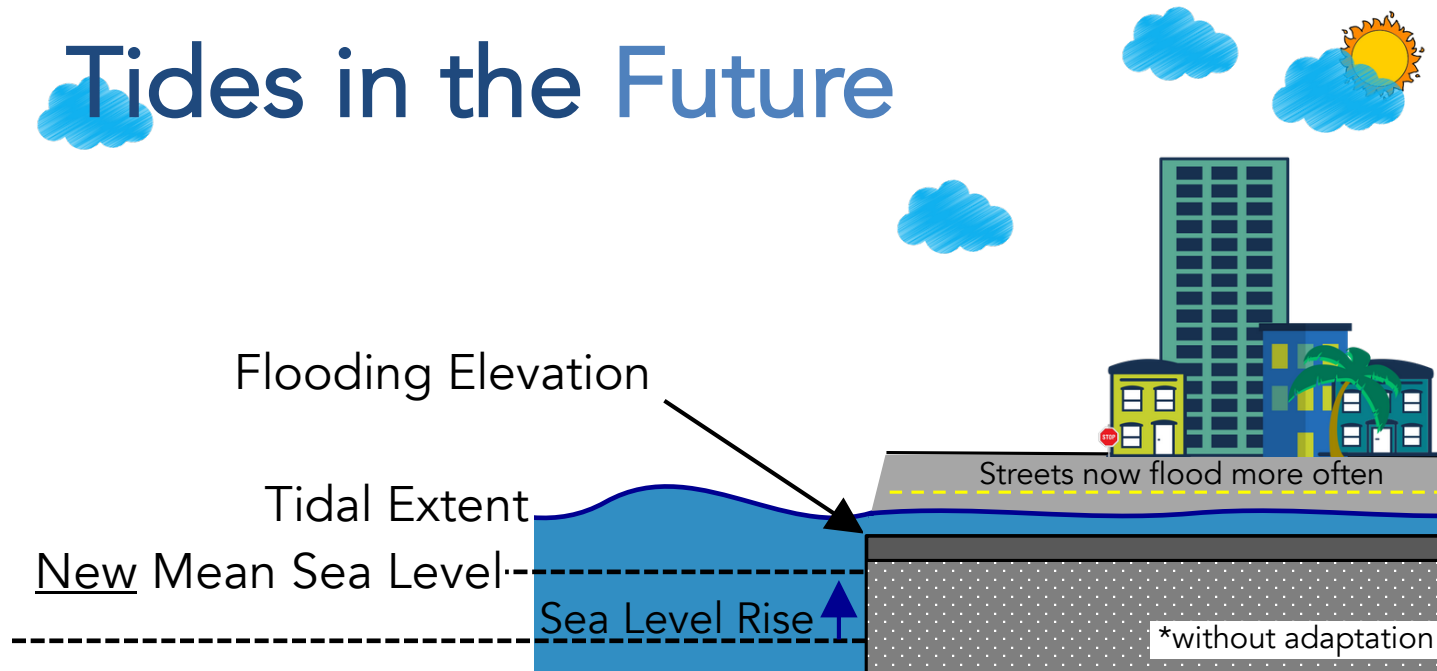
Even relatively small amounts of rain on days experiencing Sunny Day Flooding can exacerbate flooding.



Tides Today



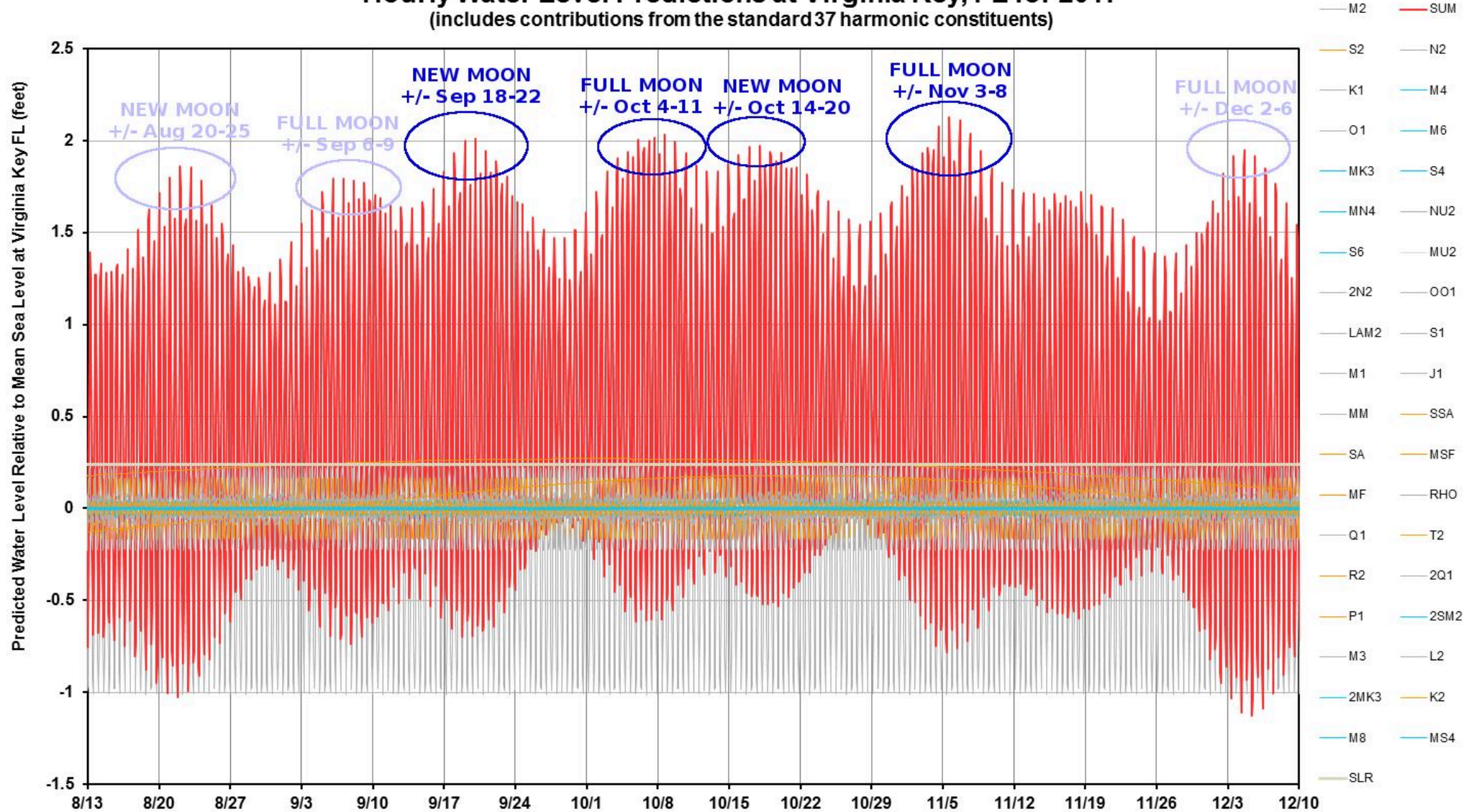
Tides in the Future



King Tides of today
will be the normal
tides of tomorrow.

Hourly Water Level Predictions at Virginia Key, FL for 2017

(includes contributions from the standard 37 harmonic constituents)



How do we know **sea levels** are rising?

- Multiple lines of evidence.
- We directly observe sea level all over the world through tidal gauges.



So what causes sea level rise?

More water in our ocean basins: As temperatures continue to warm, ice on land will melt inputting cold freshwater into the oceans.



Existing water expanding: As temperatures continue to warm, existing ocean waters will increase in volume due to thermal expansion.

