Village of Key Biscayne
Adaptation Workshop

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May 25, 2017

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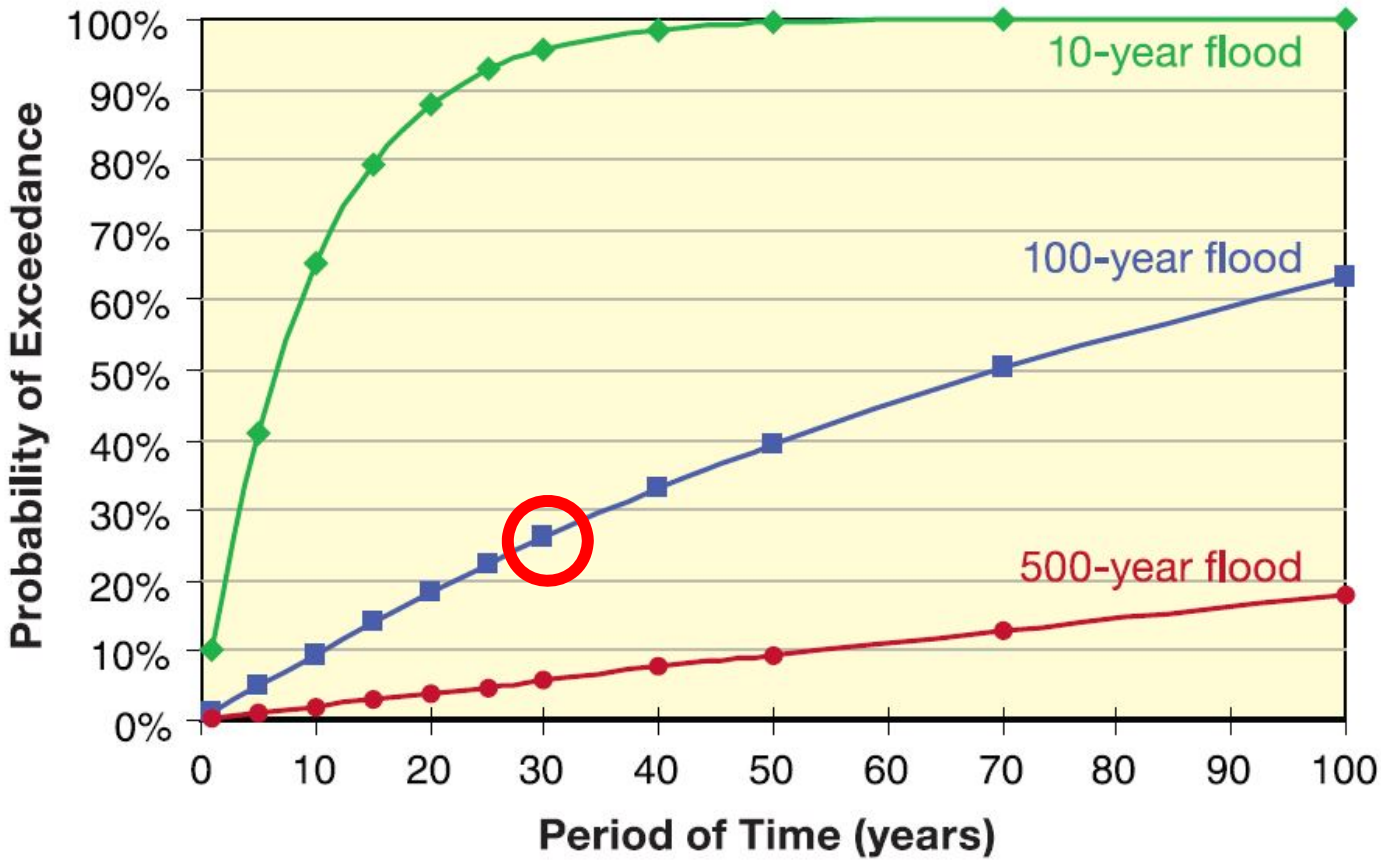
Flood Hazards

Flood Hazards

– Frequent hazard throughout Florida and especially South Florida
  - King Tides
  - Flash Flooding
  - Short but very intense rain events
  - Storms coupled with high tides
  - Hurricanes

Base Flood Elevation (BFE)

– The BFE is the flood level with a 1-percent annual chance of occurrence.



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Chance of Exceeding the BFE

– Over a 30-year mortgage, there is a **26%** chance the Base Flood will be exceeded

Length of Period (Years)	Recurrence Interval (Years)				
	10	25	50	100	500
1	10%	4%	2%	1%	0.2%
10	65%	34%	18%	10%	2%
20	88%	56%	33%	18%	2%
25	93%	64%	40%	22%	5%
30	96%	71%	45%	26%	6%
50	99+%	87%	64%	39%	10%
100	99.99+%	98%	87%	63%	18%

The table values represent the probabilities, expressed in percentages, of one or more occurrences of a flood of given magnitude or larger within a specified number of years. Probability (P) may be calculated for any given Length of Period (n) and Recurrence Interval (RI) using the following equation: $P = \left[1 - \left(1 - \frac{1}{RI}\right)^n\right] \times 100\%$, where RI and n are in years.

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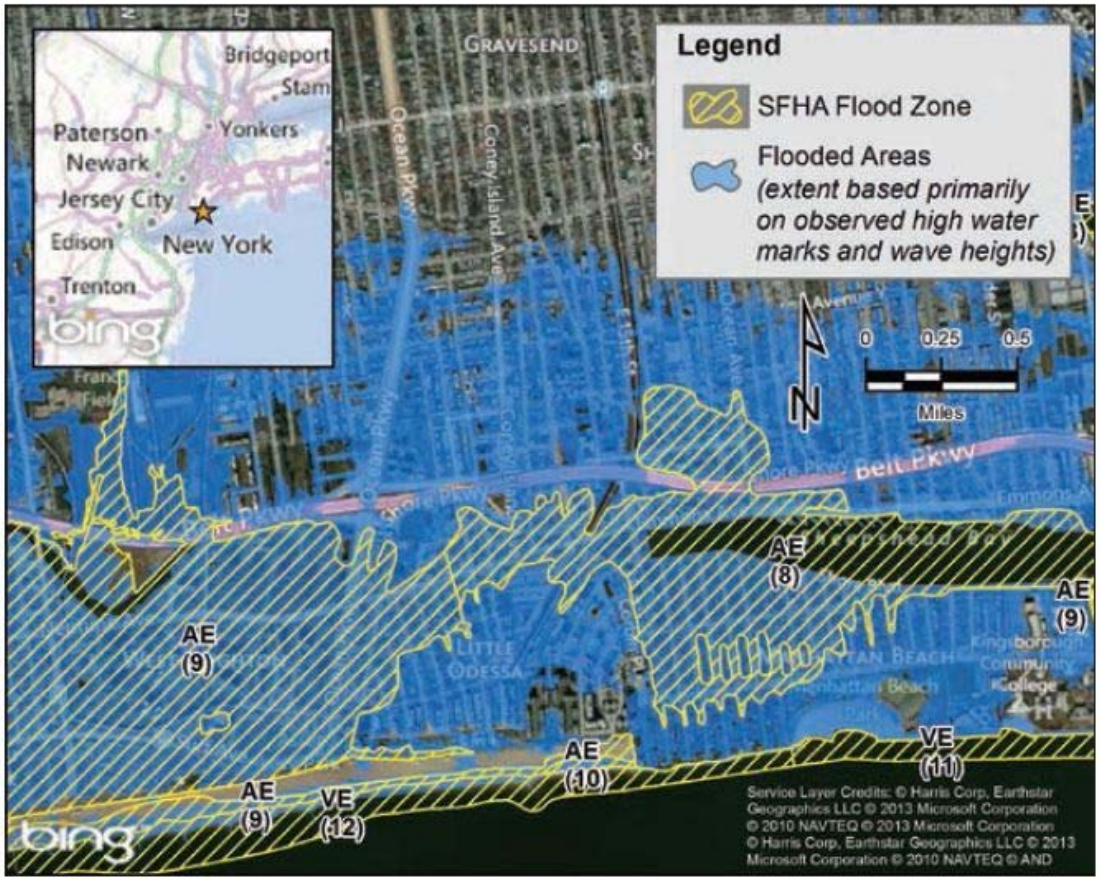
Flooding – Key Issues

– Elevating to the BFE does not provide sufficient protection against flooding. Storms more severe than the base flood frequently occur.



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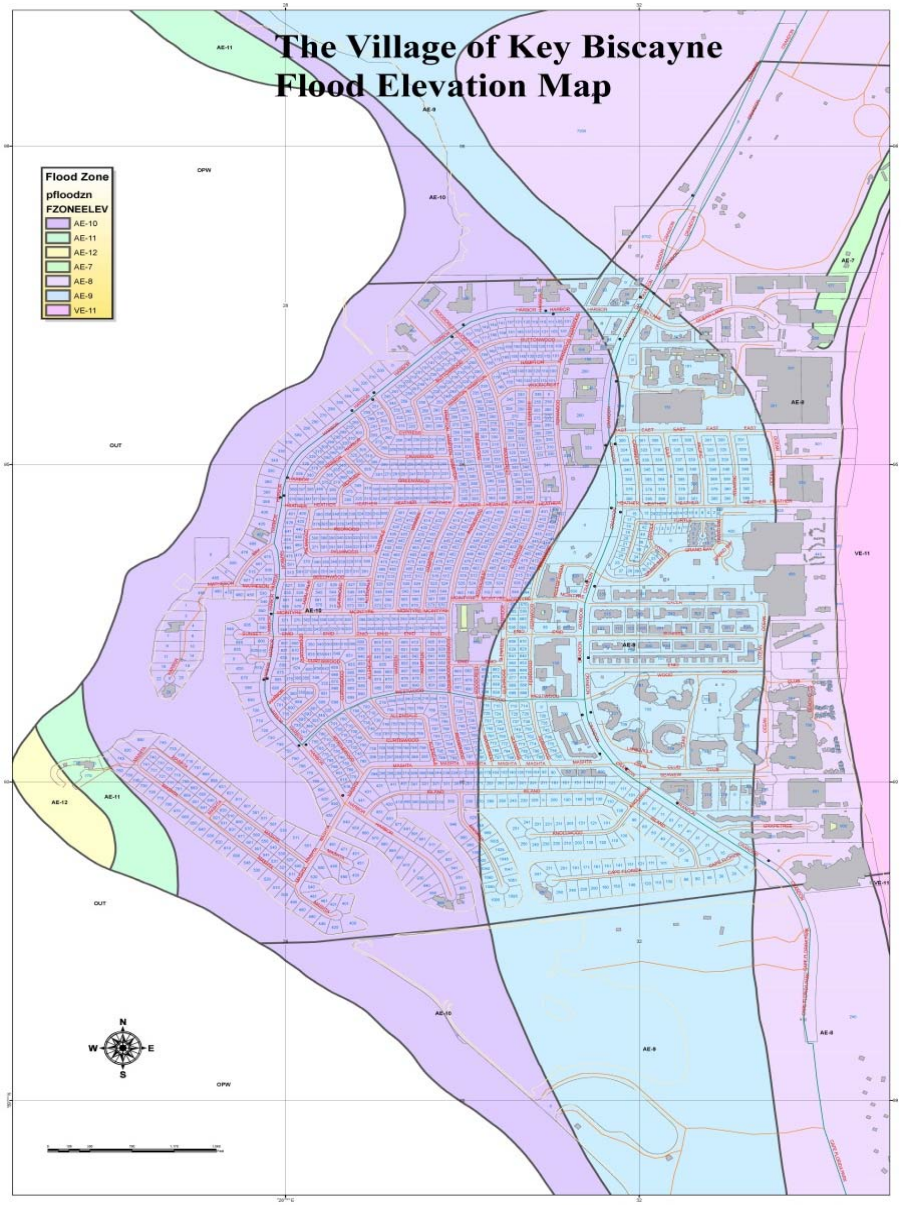
Flooding – Key Issues

– FIRMs are only as accurate as the technical information and analyses performed to create them. FIRMs are a snapshot in time and may become outdated as physical conditions, climate, and engineering methods change.



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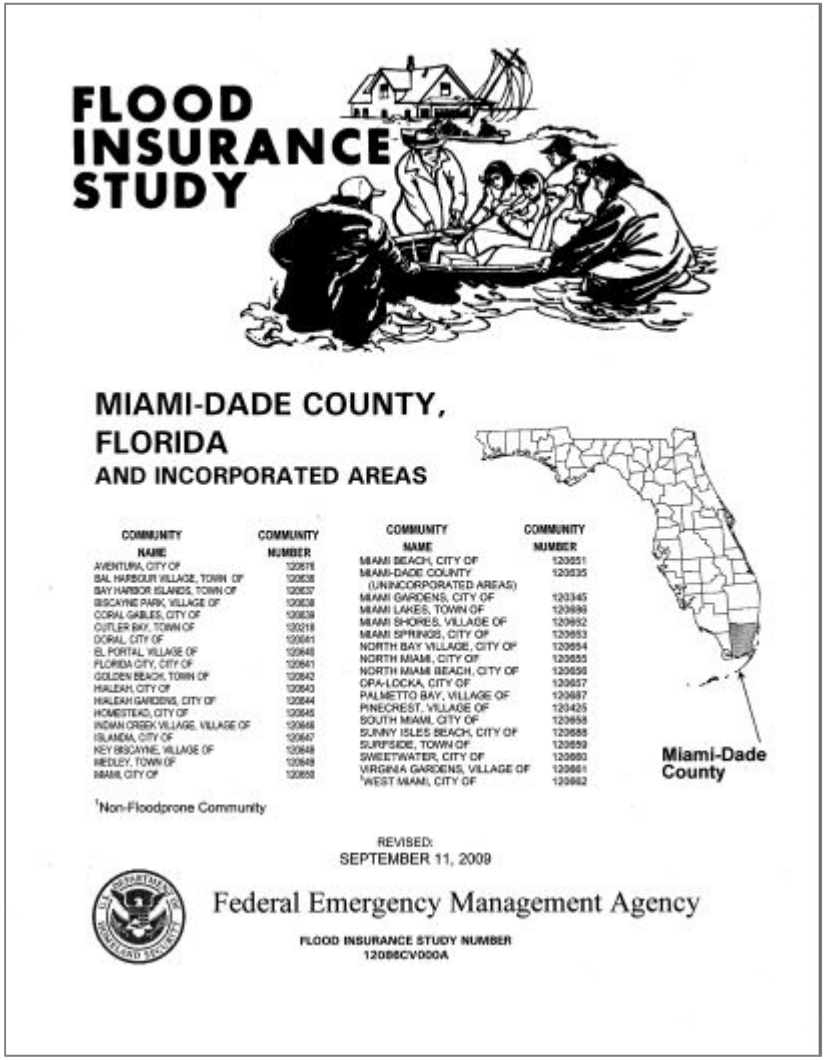
Flooding – Key Issues

– Because FIRMs reflect conditions at the time of the Flood Insurance Study, owners, designers, and communities should consider future conditions (such as sea level rise, subsidence, shoreline erosion, increased storm frequency/intensity) when deciding how high to elevate a building.



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Flooding – Key Issues

– Once flood levels exceed the lowest floor of a building, the extent of damage increases dramatically, especially in areas subject to coastal waves.

Projected Sea Level Rise

– Southeast Florida Regional Climate Change Compact

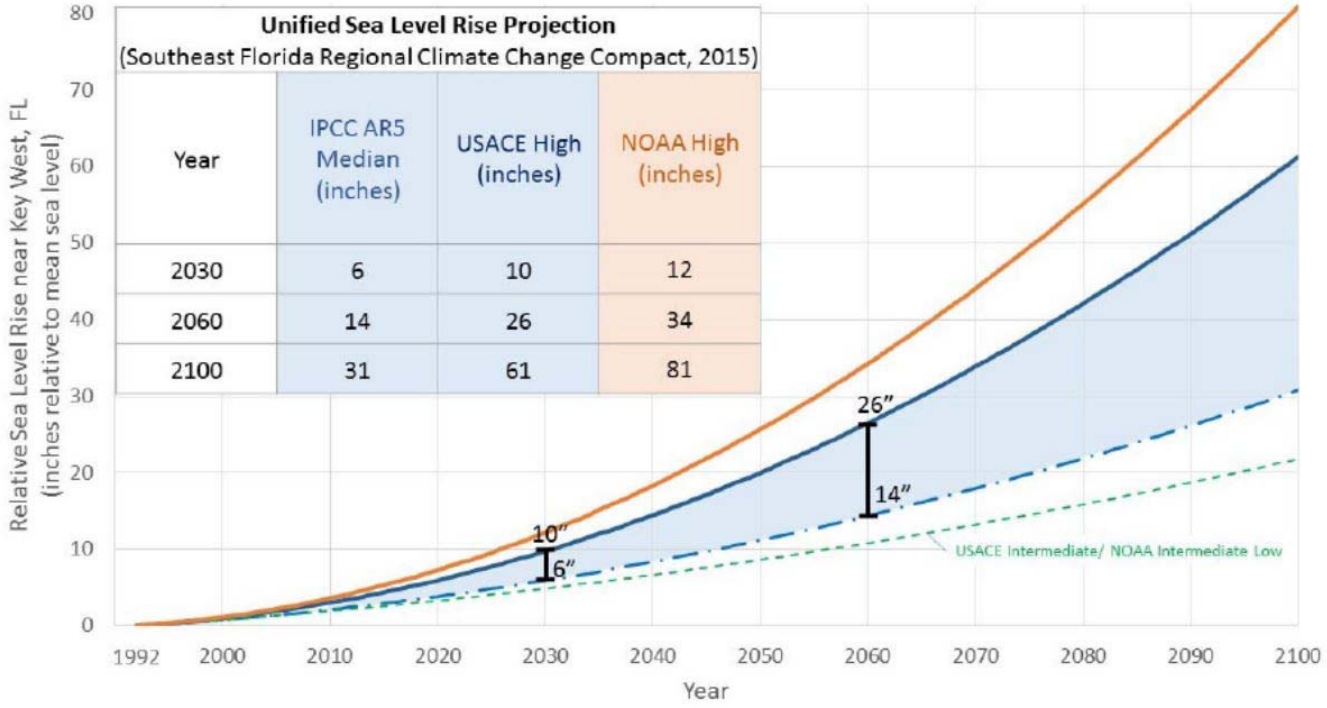

Figure 1: Unified Sea Level Rise Projection. These projections are referenced to mean sea level at the Key West tide gauge. The projection includes three global curves adapted for regional application: the median of the IPCC AR5 RCP8.5 scenario as the lowest boundary (blue dashed curve), the USACE High curve as the upper boundary for the short term for use until 2060 (solid blue line), and the NOAA High curve as the uppermost boundary for medium and long term use (orange solid curve). The incorporated table lists the projection values at years 2030, 2060 and 2100. The USACE Intermediate or NOAA Intermediate Low curve is displayed on the figure for reference (green dashed curve). This scenario would require significant reductions in greenhouse gas emissions in order to be plausible and does not reflect current emissions trends.

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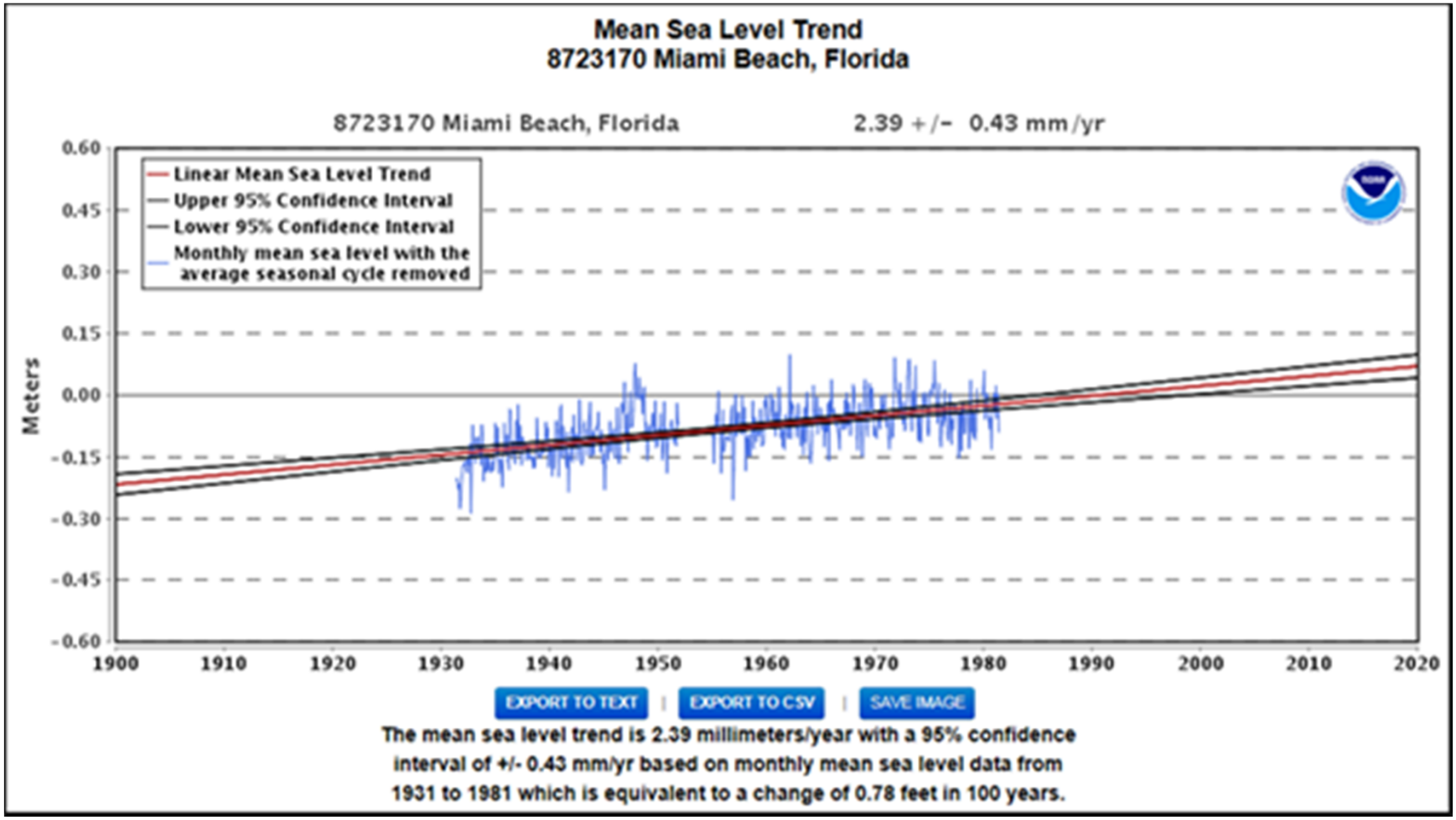
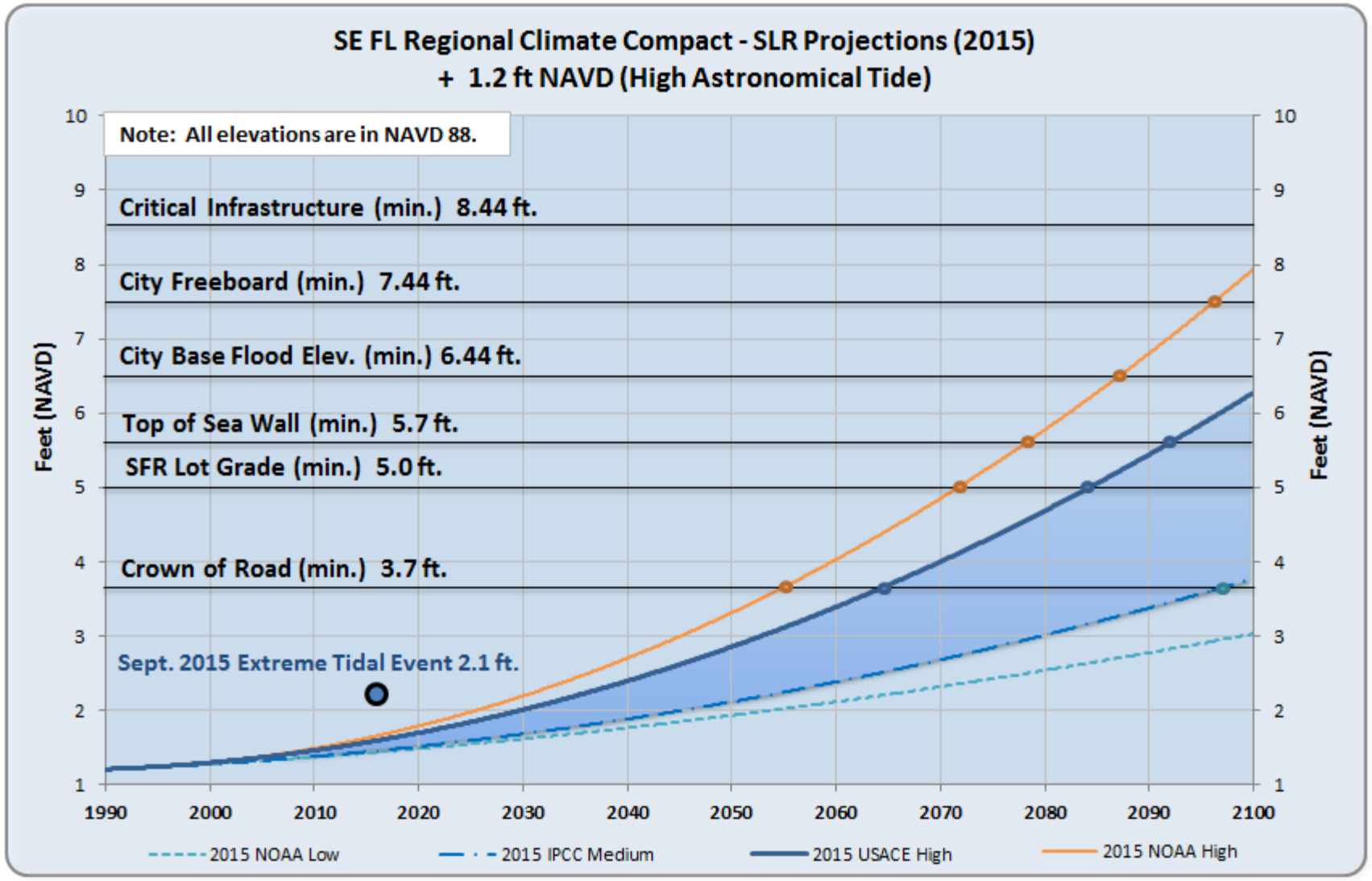
Mean Sea Level Measurements for Virginia Key



https://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?stnid=8723170

Miami Beach Sea Level Rise Guidance



http://www.southeastfloridaclimatecompact.org/wp-content/uploads/2015/10/2015-Compact-Unified-Sea-Level-Rise-Projection.pdf

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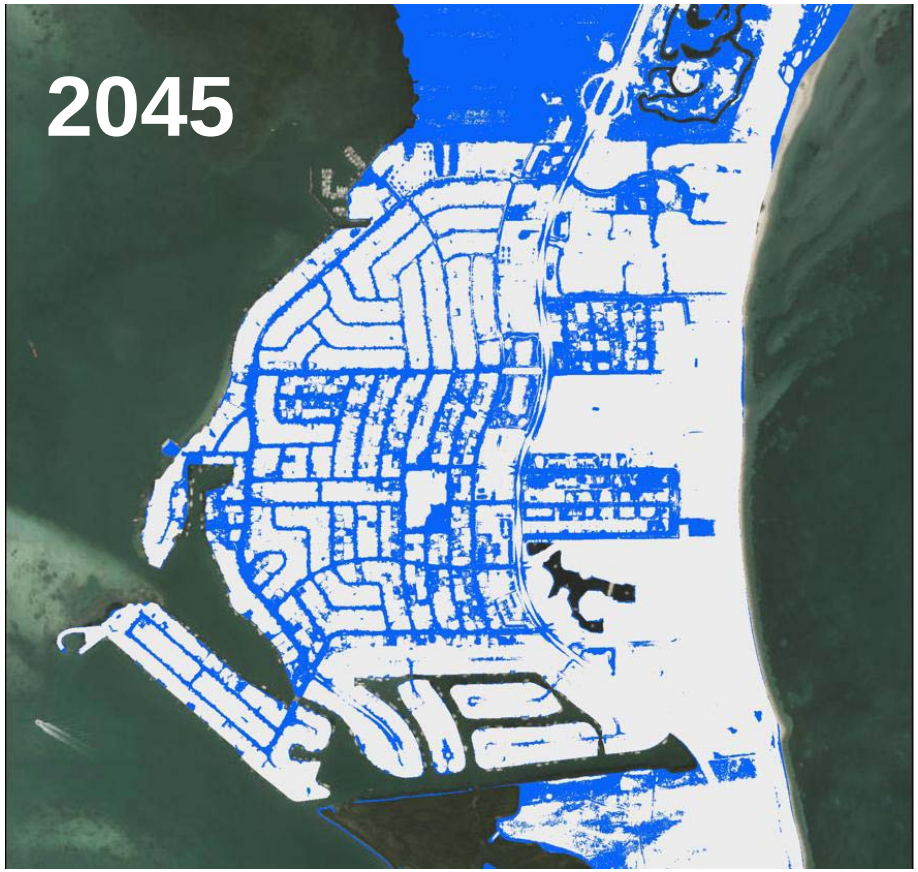
Flood Vulnerability Assessment & Adaptation Report (April 2017)

Coastal Risk Consulting

Tidal Flooding

– Due to Sea Level Rise, tidal flooding is expected to increase substantially by the year 2045



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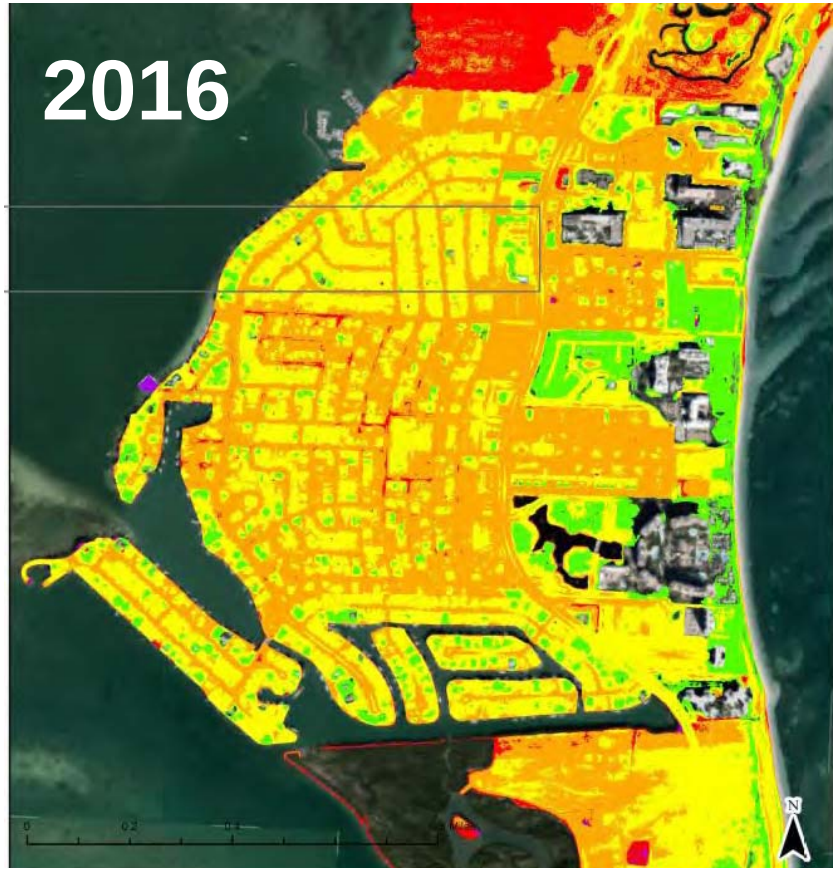
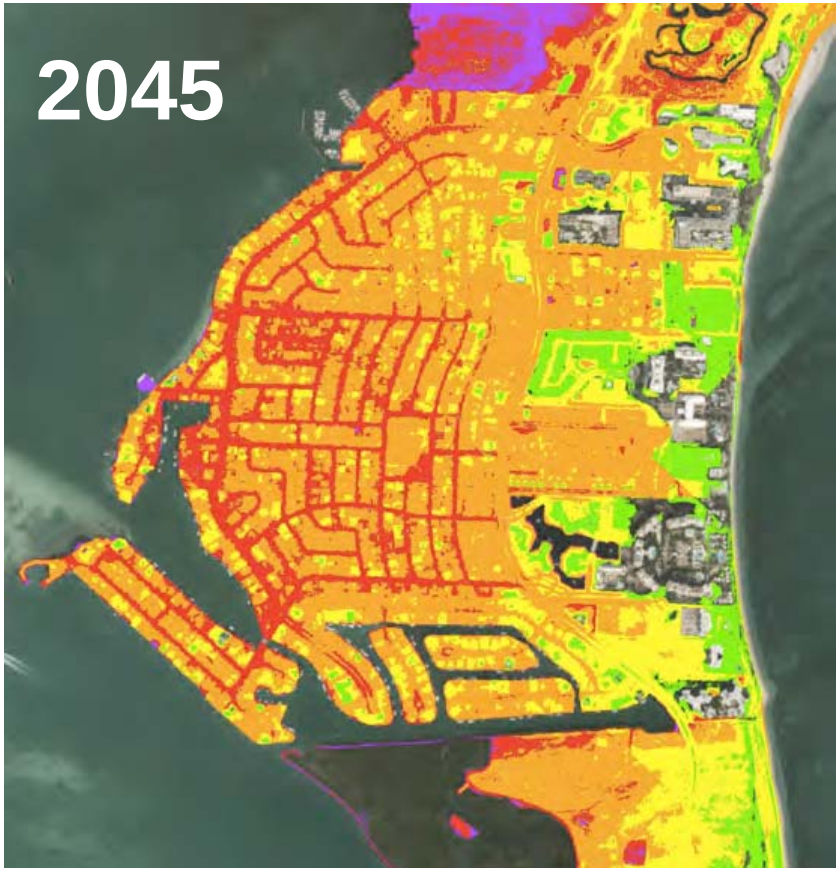
Storm Surge Flooding

– Category 3 Hurricane - Predicted Storm Surge





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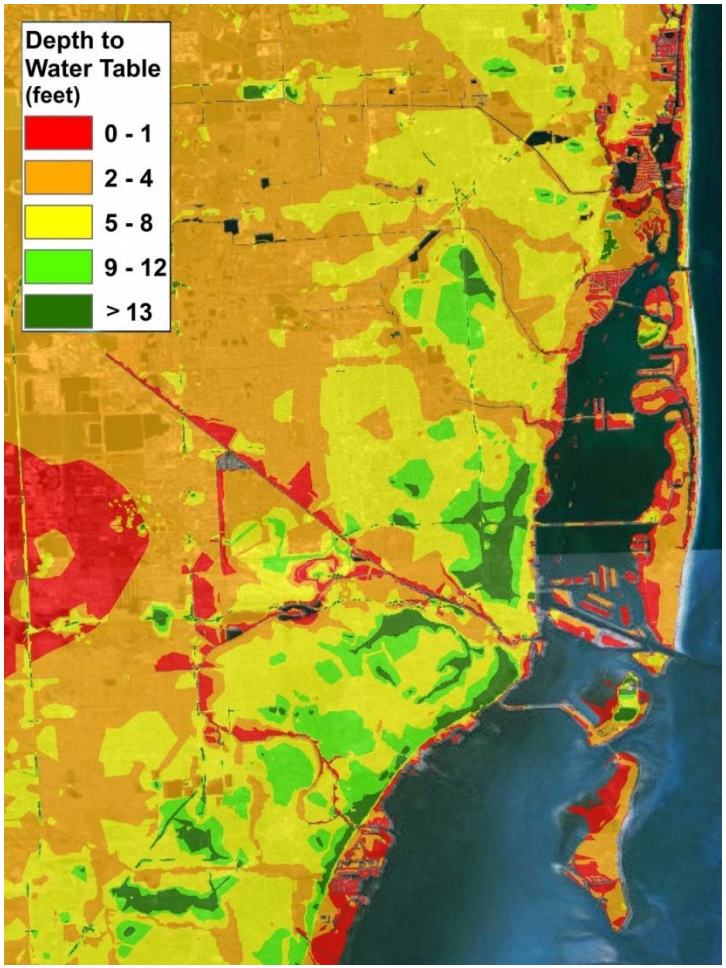
Rainfall Flooding

– Flooding occurs when rainfall exceeds the drainage and ground storage capacity



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Proposed Floodplain Ordinance

Model Ordinance

– The Florida Division of Emergency Management developed a model ordinance that is coordinated with the Florida Building Code (FBC) and satisfies the requirements of the National Flood Insurance Program (NFIP)

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Proposed Floodplain Ordinance

The Village of Key Biscayne is in the process of adopting the model ordinance with a few higher standards:

– Cumulative Substantial Improvement

– Additional elevation (freeboard)

And a few provisions carried over from the current floodplain ordinance

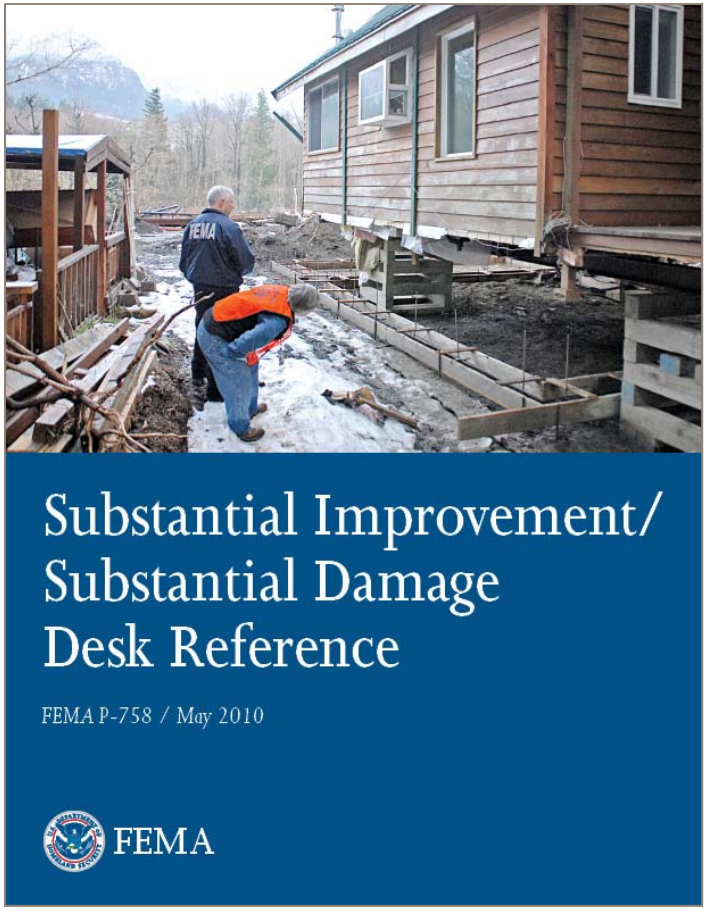
– Limits on Enclosures

– Requirement to show drainage on site plans

– Limitations on disposition of rainwater and liquid wastes

Cumulative Substantial Improvement

- The proposed ordinance includes a Cumulative Substantial Improvement meaning that the cumulative cost (over a 1 year period) of improvements that equal or exceeds 50 percent of the Market Value of the building or structure before the improvement or repair is started will trigger the requirement for the whole building to be brought into compliance with the current floodplain regulations.
- Some requirements include:
  - Elevation to or above the BFE
  - Use of flood-damage resistant materials below the BFE
  - Open foundations in Zone V
  - Flood openings in Zone A
  - Elevation of utilities



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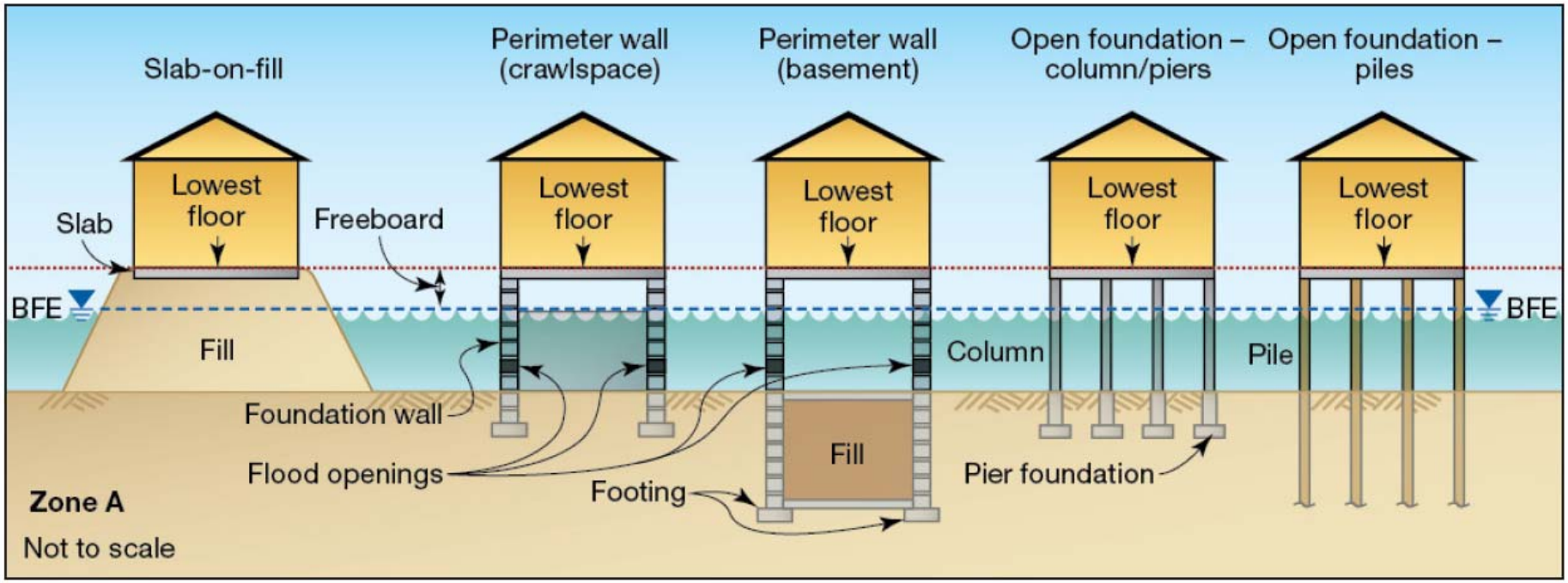
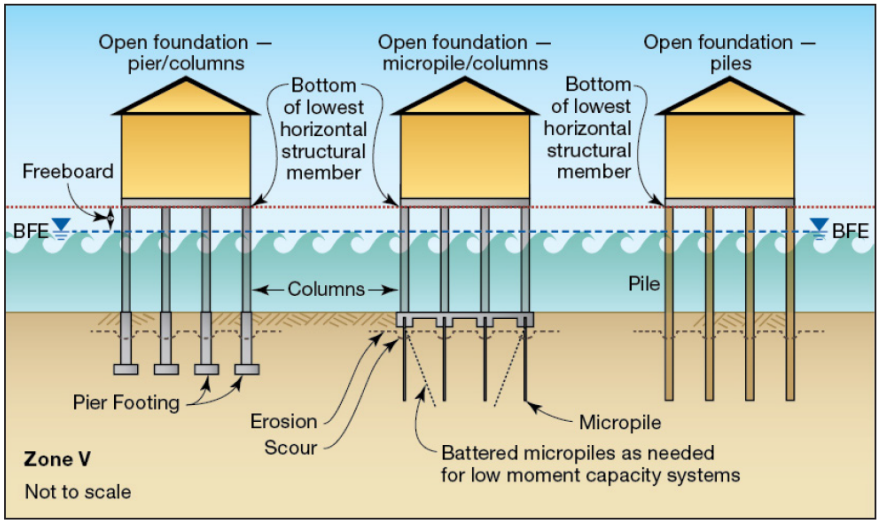
Cumulative Substantial Improvement





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Benefits of Cumulative Substantial Improvement

- Reduces likelihood of deliberately phasing improvements to avoid “50% rule”
- Credited under CRS
- Speeds up bringing all flood-prone structures into NFIP compliance
- Reduces future flood damage

Impacts of Cumulative Substantial Improvement

- Higher initial cost to bring the entire structure into compliance
- Requires extra record-keeping and administrative procedures

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Additional Elevation (Freeboard)

a) One- and Two-Family Dwellings. One- and two-family dwellings, shall be developed in accordance with the minimum elevation requirements of the Florida Building Code, plus one foot. (2' above BFE)

b) Developments Other Than One- and Two-Family Dwellings. All developments other than one- and two-family dwellings shall be developed in accordance with the minimum elevation requirements of the Florida Building Code, plus two feet. (3' above BFE)

c) Critical Facilities. All Critical Facilities shall be elevated or protected to or above the 500-year flood elevation plus one foot. (2' above 500-year)

Best Practices

May 25, 2017

Best Practices for Mitigating Flood Vulnerability

- Structure elevation
- Street and sidewalk elevation
- Permeable pavement
- Seawall elevation
- Utilities

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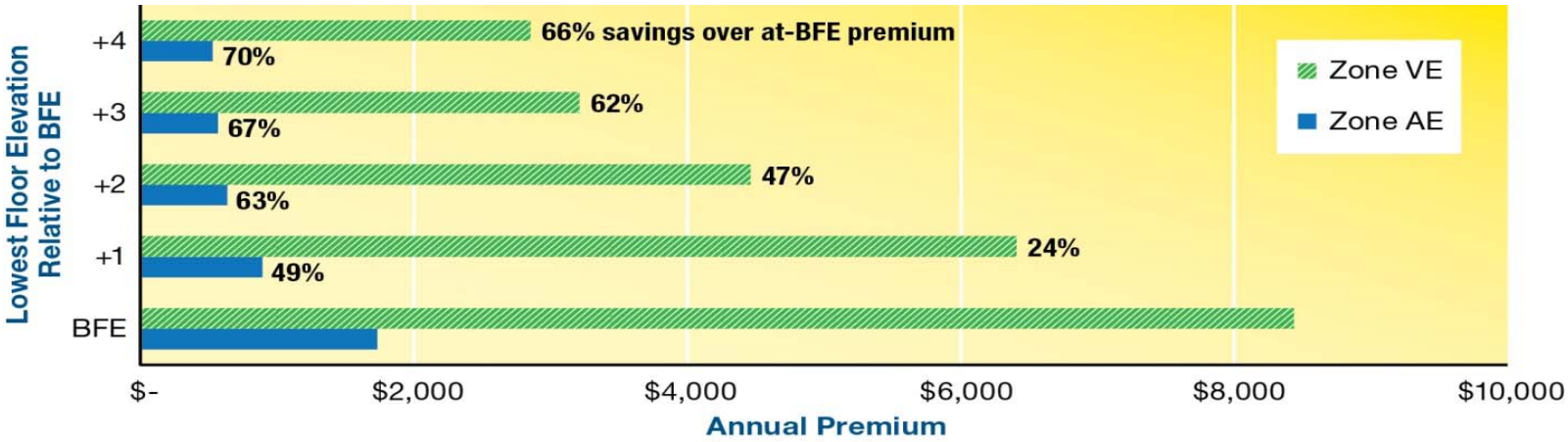
Structure Elevation

– Recommend elevating at least 3 feet above BFE
  - Flood insurance premiums drop significantly as freeboard increases
  - Revised FIRMs may show higher BFEs and increased flood risk.



Note: Annual premiums calculated using the *NFIP Flood Insurance Manual*, October 1, 2014, for a one-story single-family home with no basement, no enclosure, and full replacement coverage. Premiums are based on the maximum available coverage of building coverage of $250,000 for building and $100,000 for contents coverage. Zone V building is assumed to be free of obstructions.

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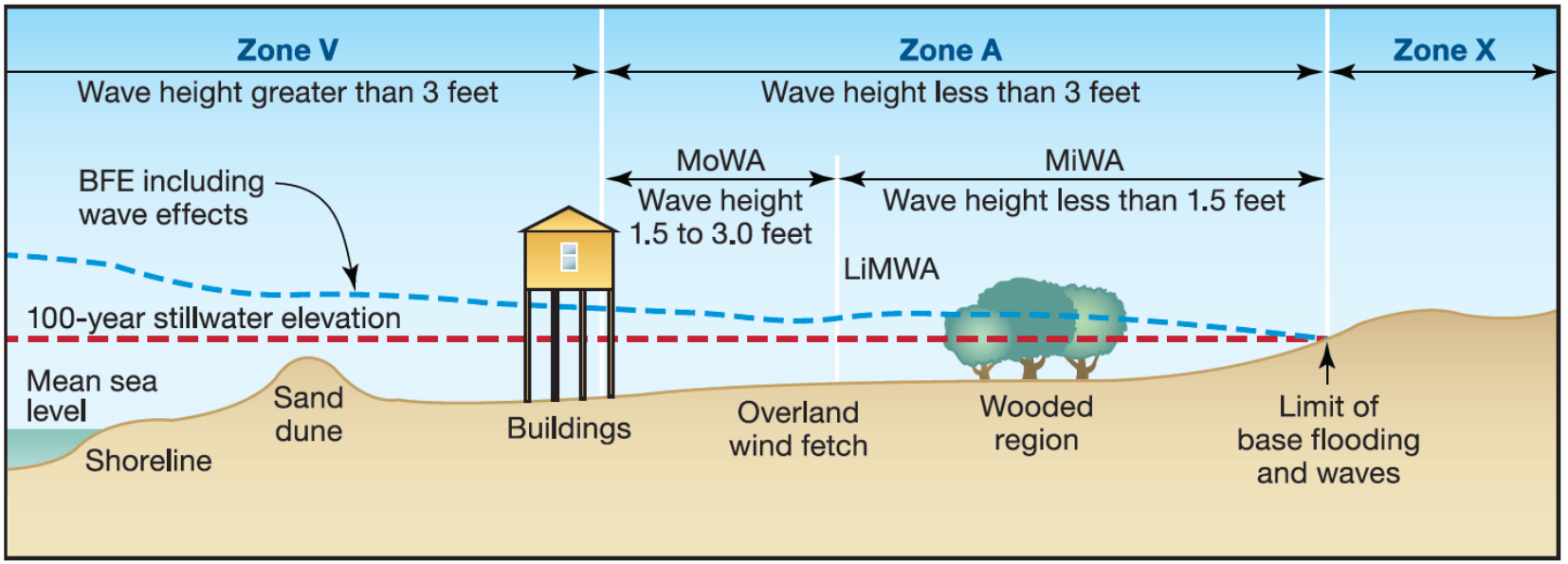
Structure Elevation

– Recommend building to Zone V Standards in Coastal A Zones

- Homes in the Coastal A Zones are subject to moderate wave action (1.5-3’ waves)



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Advantages of Elevation

Reduced damage and quicker reoccupation after floods

- Less burden on government & nonprofits for assistance
- More money spent locally to help tax revenues recover
- Property owners use less savings & borrow less for repairs
- Small businesses more likely to stay open

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Elevation Works!

2005: Post Katrina

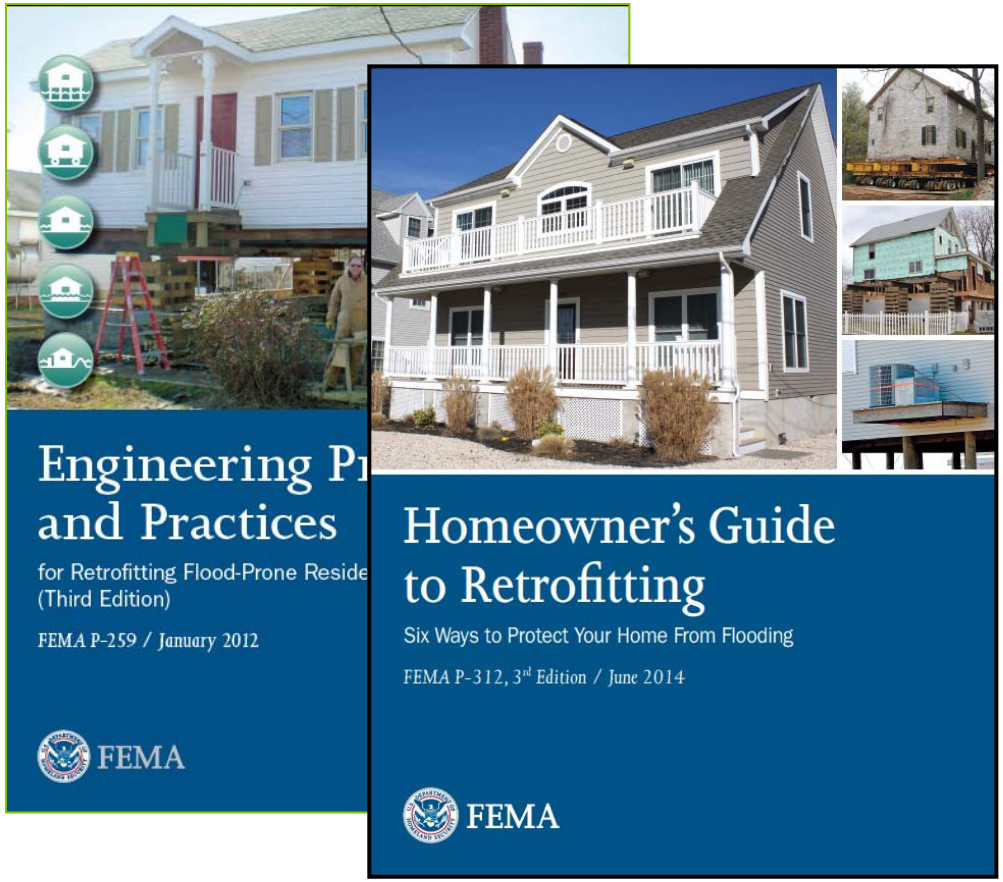
2012: Post Isaac

Disadvantages of Elevation

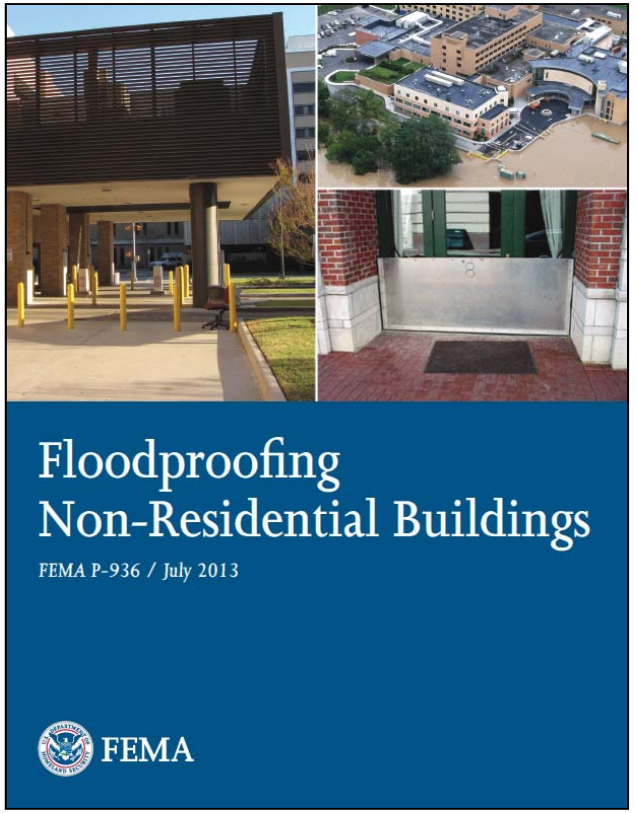
- Could conflict with building height restrictions in the zoning code
  - Height restrictions could be tied to the required elevation (BFE or DFE), so would be flexible as conditions change
- Elevating the structure adds to initial construction cost
  - But the initial costs are recuperated over the life of the structure due to flood damages avoided and flood insurance premium savings

FEMA Publications

– Residential



– Non-Residential



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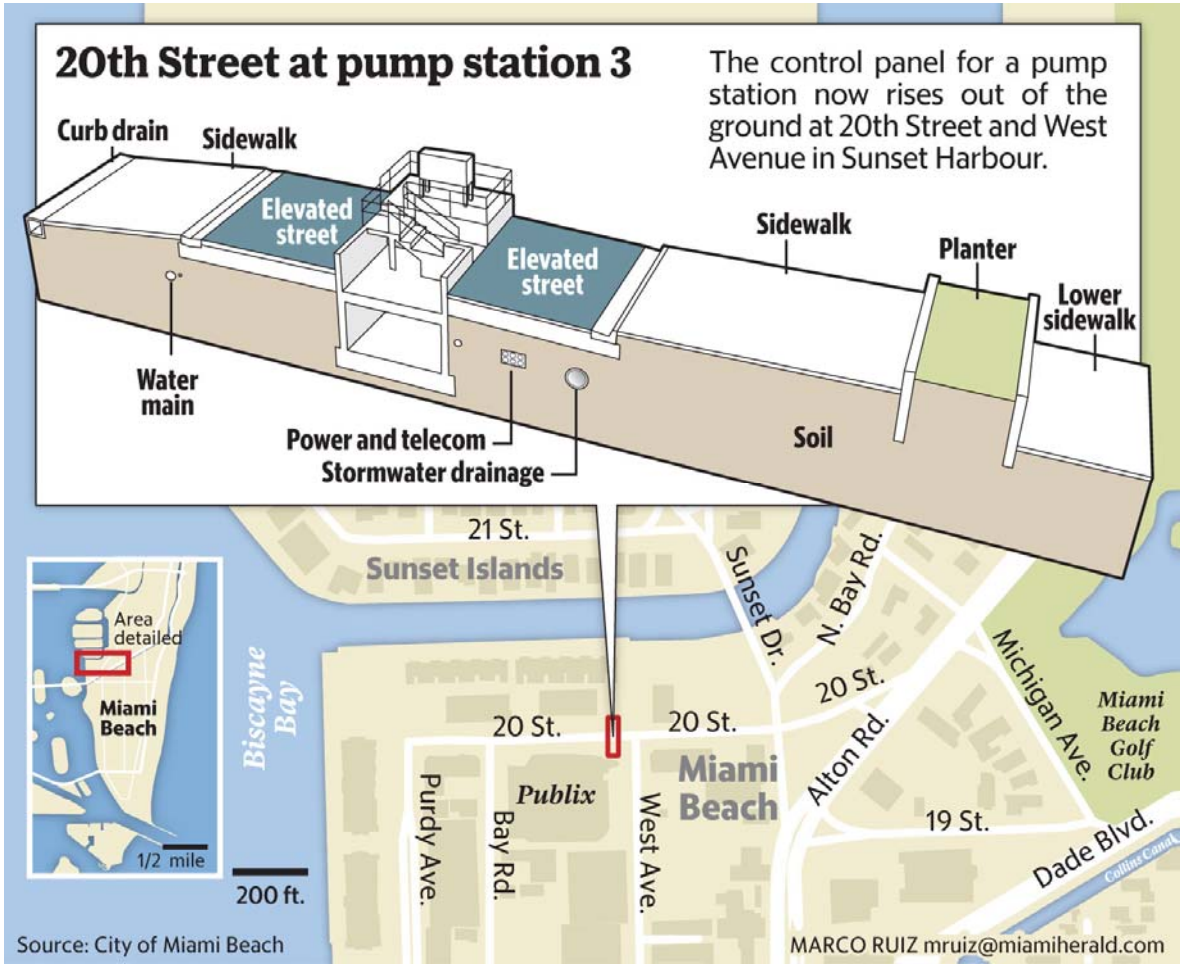
Road and Sidewalk Elevation

– Miami Beach is in the process of elevating streets

– Utilities are buried beneath the elevated roads



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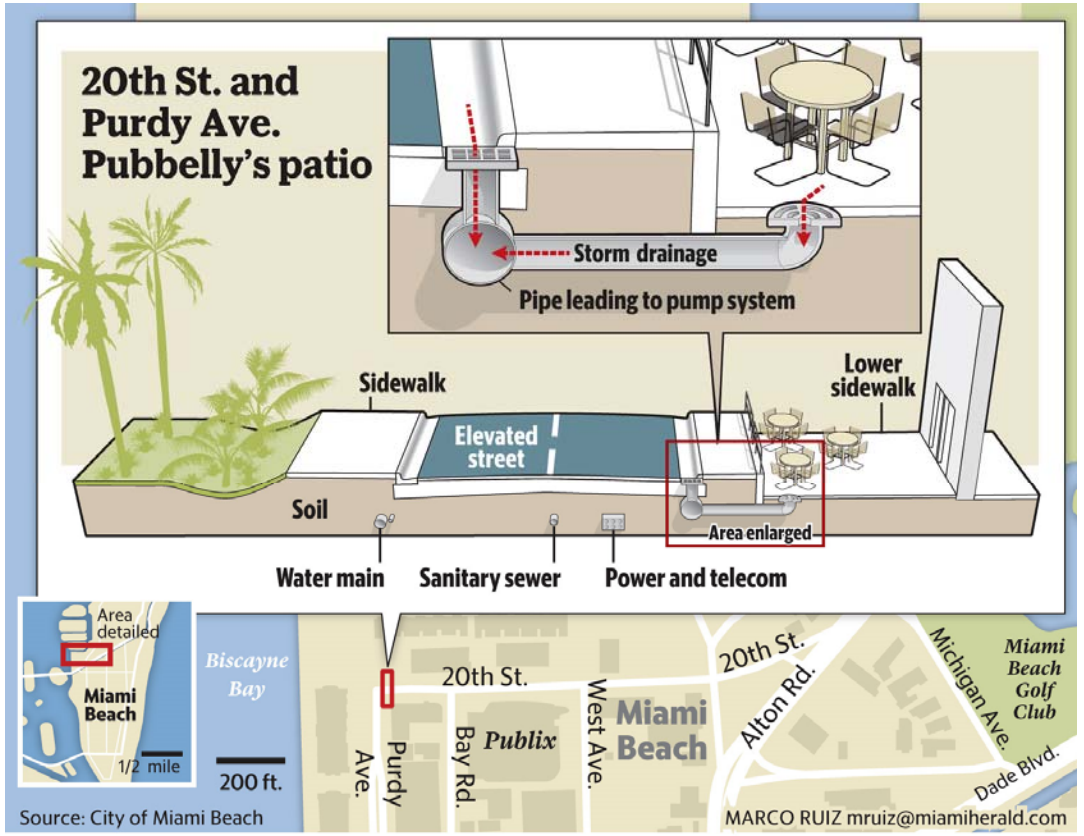
Road and Sidewalk Elevation

– Water that would be trapped by the elevated streets and sidewalks is drained into the underground storm drains

– This requires cooperation from adjacent property owners



This rendering shows the elevated roadway at 20th Street and Purdy Avenue, in front of Pubbelly restaurant. To the right, the patio in front of Pubbelly is about two feet lower than the street. Floor drains down there feed into the same pipes that connect to the curb drains on the road, which routes water to the pump station.

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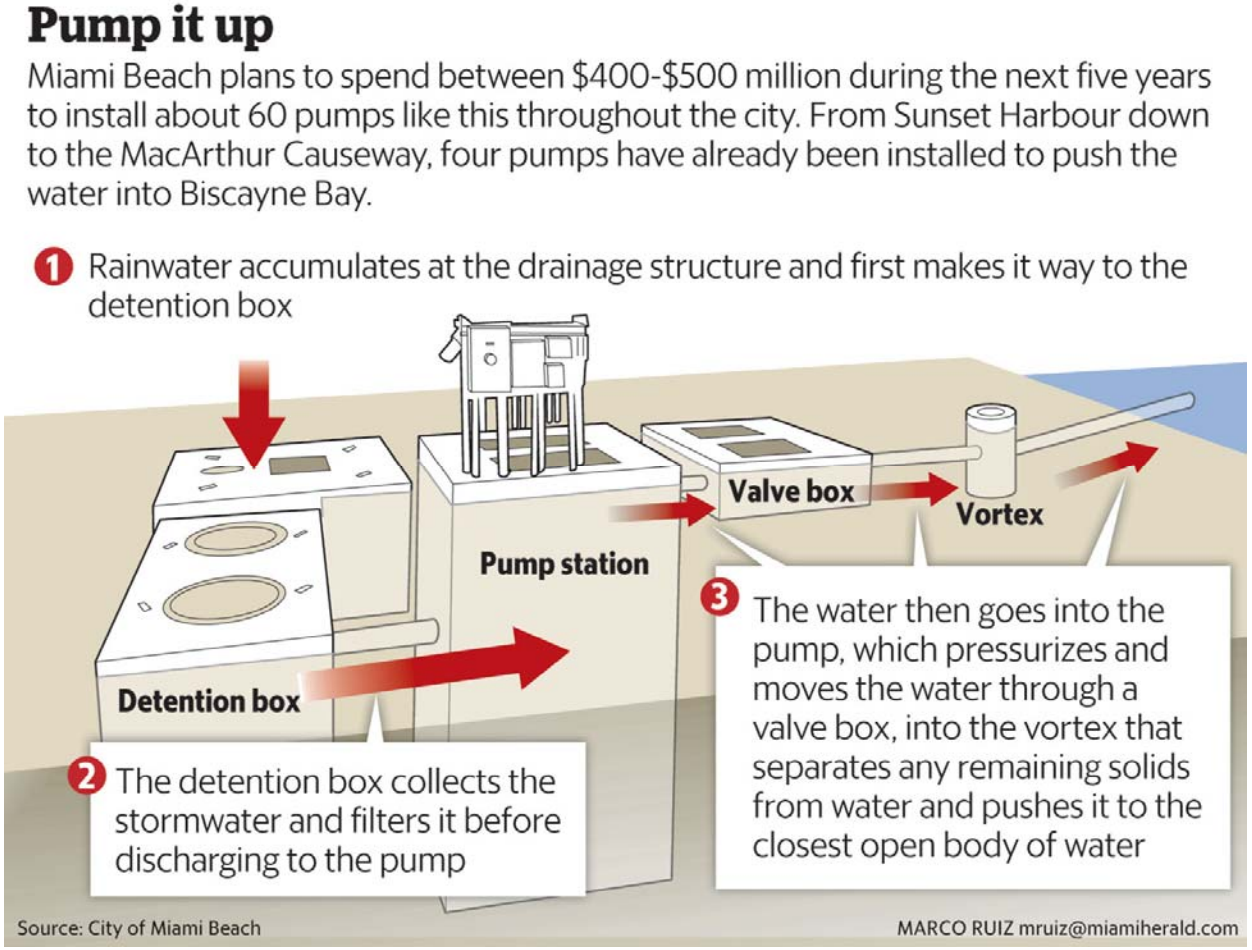
Road and Sidewalk Elevation

– Water from the elevated streets and residential properties is collected, filtered, and discharged into Biscayne Bay



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Road and Sidewalk Elevation - Disadvantages

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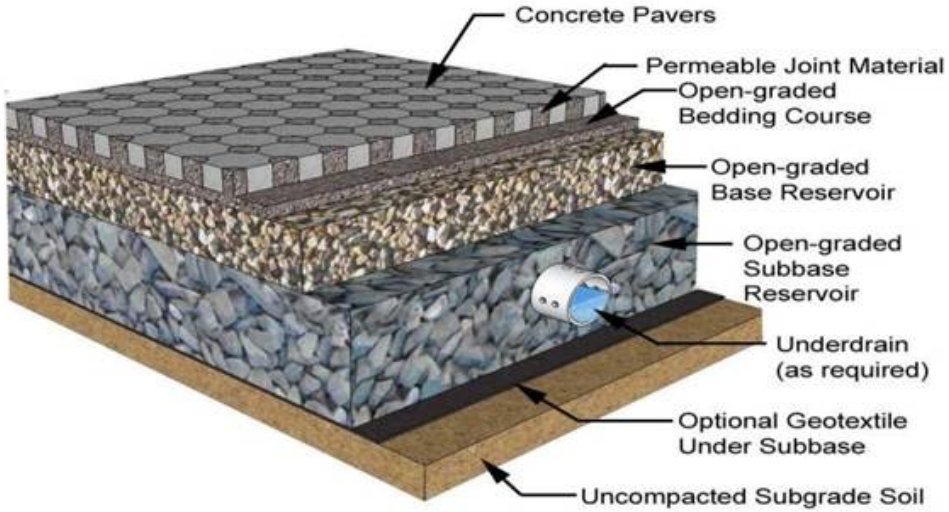
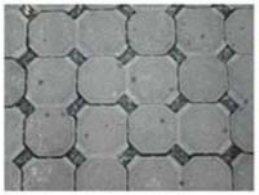
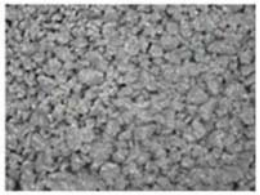
Permeable Pavement





Permeable Interlocking Concrete Pavers (PICP)

Concrete Grid Pavers (CGP) "Turfstone"



Porous Concrete (PC)

Porous Asphalt (PA)

Plastic Turf Reinforcing Grids (PTRG)

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Permeable Pavement - Advantages

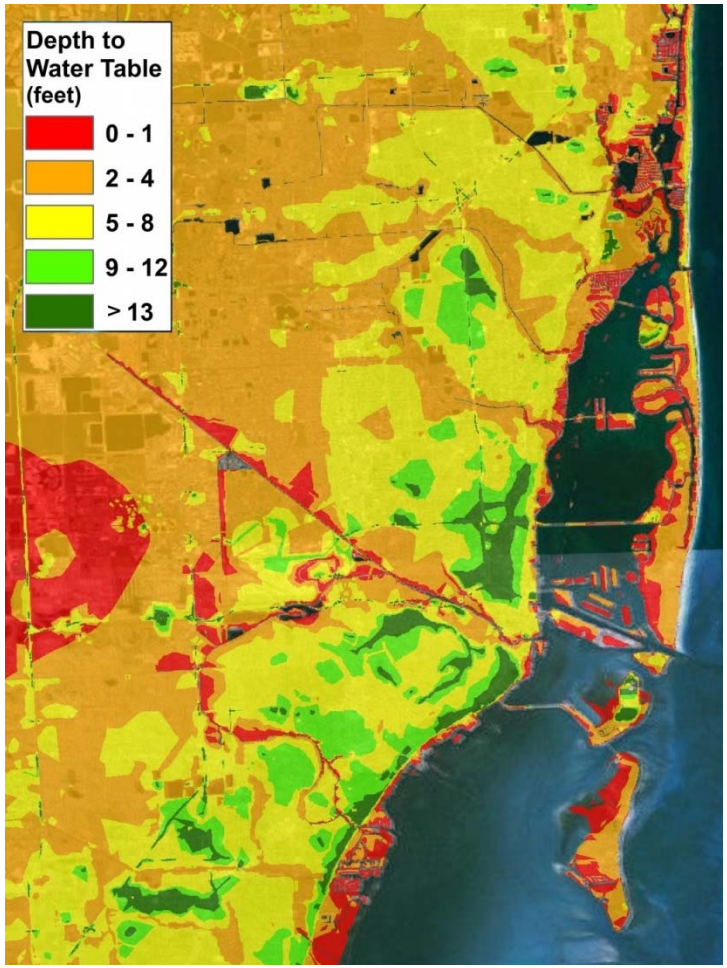
- Can reduce stormwater runoff volume from paved surfaces
- Can reduce peak discharge rates
- Can reduce pollutant transport
- Can get LEED Green Building Rating System credits

Permeable Pavement - Disadvantages

- Can only be used on gentle slopes (<5%)
- Cannot be used in high-traffic areas or where it will be subject to heavy axle loads
- Can be prone to clogging from sand and fine sediments that fill void spaces and the joints between pavers
- Periodic maintenance is critical, and surfaces should be cleaned with a vacuum sweeper at least three times per year

Permeable Pavement – Design Considerations

- With the high water table and increasing sea levels, permeable pavement may allow water to infiltrate up out of the ground, causing flooding
- Not much runoff storage available in the ground where the water table is high
- Minimum Depth to Water Table of 2 feet must be provided between the bottom of the permeable pavement installation (i.e., the bottom invert of the reservoir layer) and the seasonal high water table



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Seawall Elevation – Best Practices

– Wall elevation should consider the following parameters over the design life of the structure:
  - potential wave height
  - extreme high tides
  - storm surge
  - sea level rise

Note that FEMA FIRM updates are expected in 2018. It might be wise to wait for the updated maps before setting a new minimum height

Utilities

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Florida Power and Light

– More than 37 percent of our current system is already underground

– More than two-thirds of FPL's new distribution lines have been placed underground

Advantages and Disadvantages of Buried Power Lines

– Advantages
  - Better reliability in normal and adverse weather conditions, especially during wind and lightning events
  - Fewer number of power interruptions
  - No poles or overhead wires in the conversion area

– Disadvantages
  - Longer duration of outages
  - More susceptible to flooding, which delays restoration efforts
  - Repairs of underground lines may require pre-arranged outages and excavation of private property

– **We recommend raising critical power infrastructure on buildings above BFE + freeboard**

Utility Best Practices

– Redundant systems - Building owners should provide emergency back-up power systems for facilities and protect them from flood damage

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Thank You