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# Buildings in Harm's Way

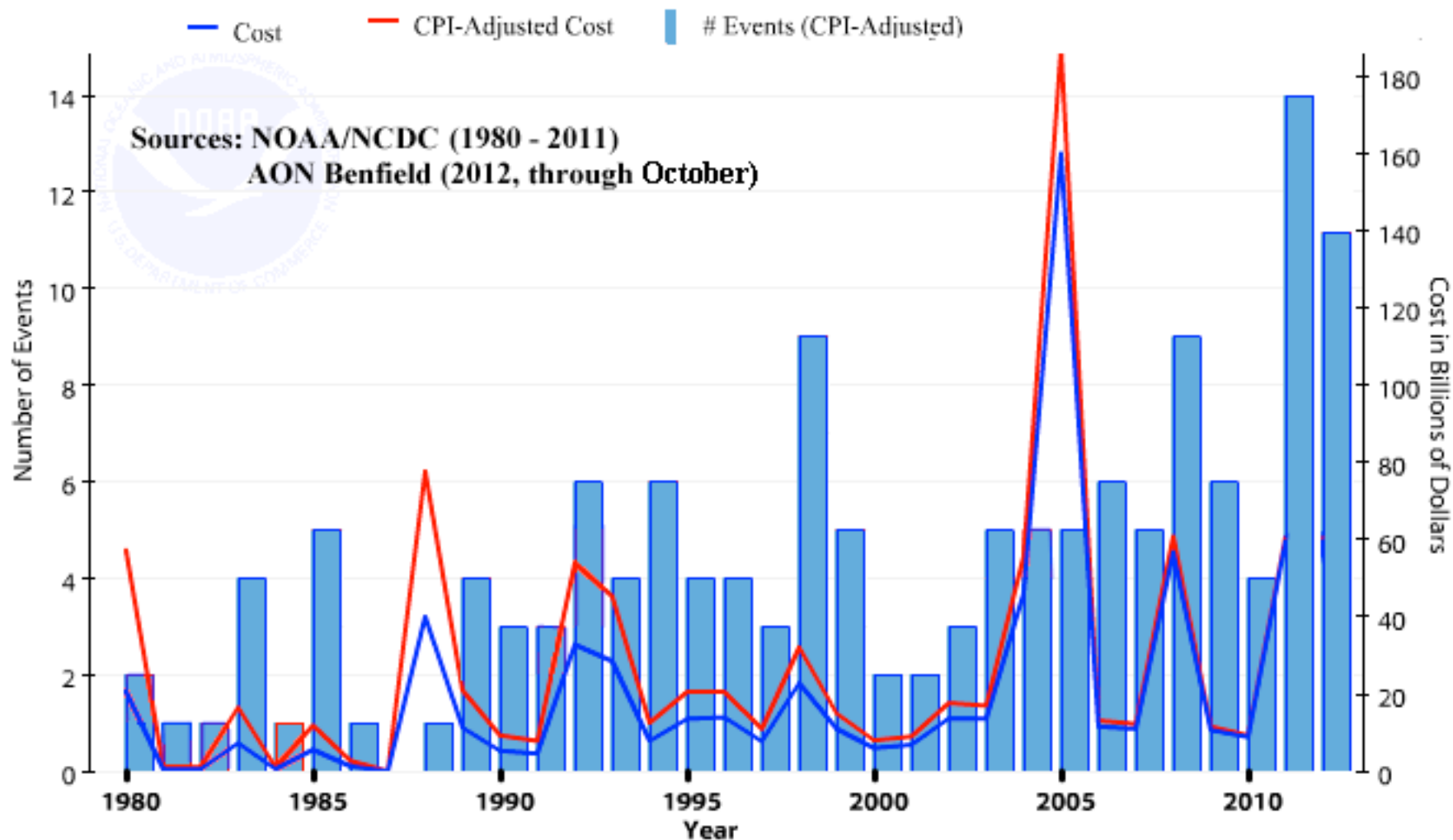
*Local Solution: Northeast Climate  
Change Preparedness Conference*

**Dr. Sarah Slaughter**

Built Environment Coalition



# Billion-Dollar U.S. Weather Disasters, 1980 - 2012





<http://learning.blogs.nytimes.com>



<http://cbsboston.files.wordpress.com/2014/01/truck2.jpg>



<http://www.weather.co>



<http://usnews.nbcnews.com>

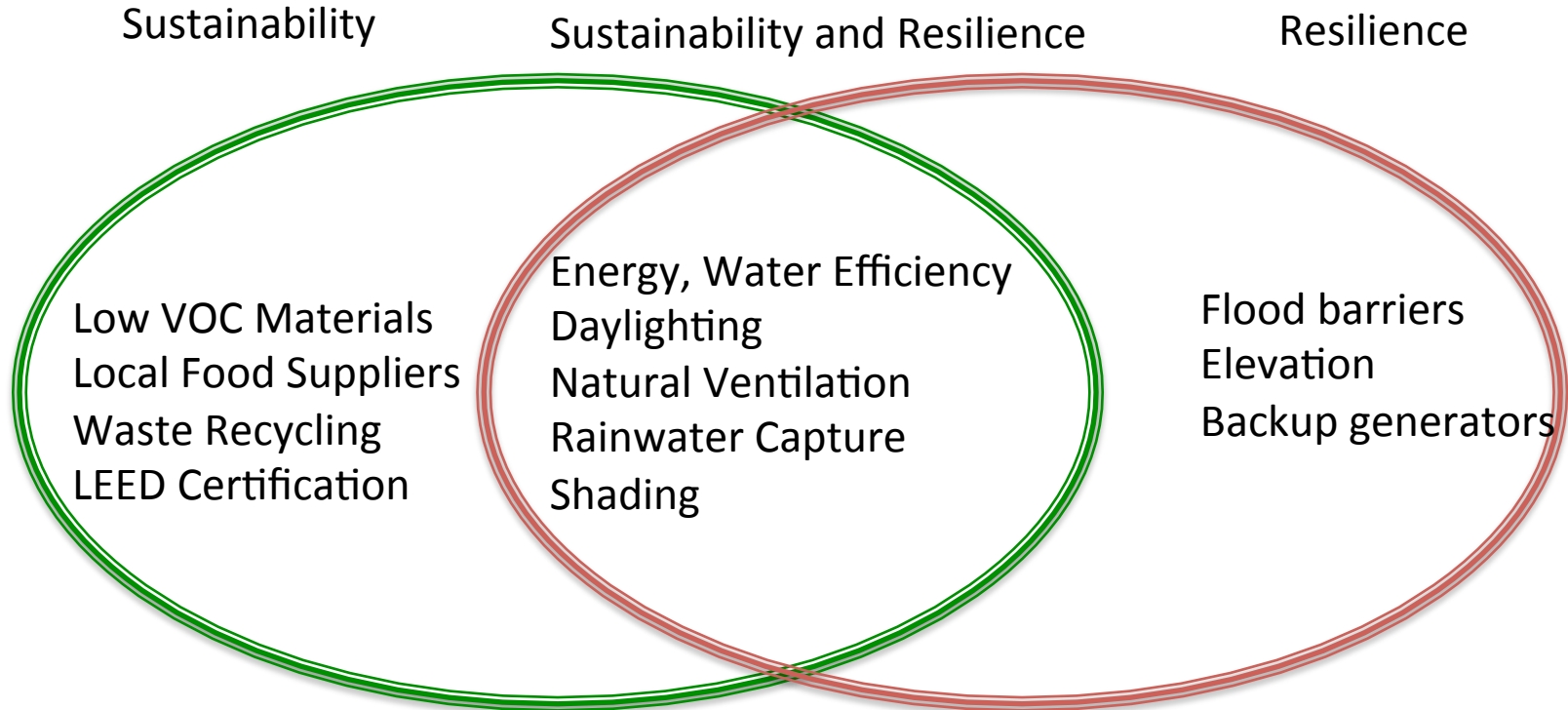


# HOW HOT IT WILL FEEL WEDNESDAY (°F)



# Sustainability and Resilience

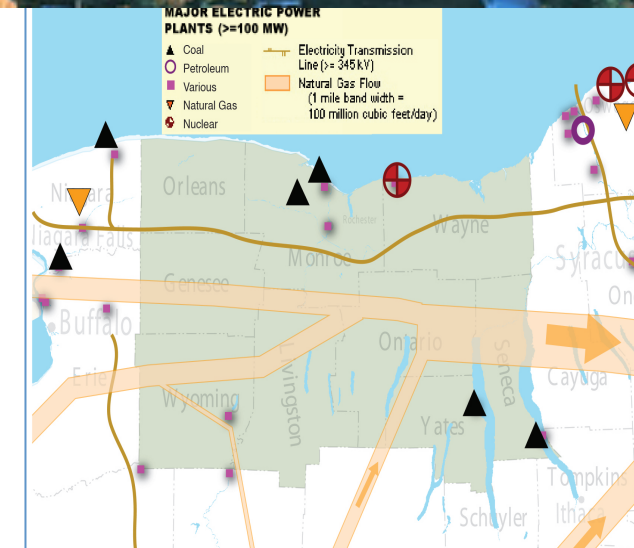
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# Framework for Planning for Resilience and Sustainability



- Characterize Community's **Critical Assets**
- Assess **Vulnerabilities** of Assets to Extreme Conditions
- Identify **Intervention Points, Strategies, Solution Sets**
- Plan for Resilience in All **Capital Investments**





# Critical Community Assets

- Critical Built Facilities
  - Emergency Response (Police, Fire, EMT)
  - Hospitals and Medical Care
  - Schools
  - Production Facilities
- Natural Systems

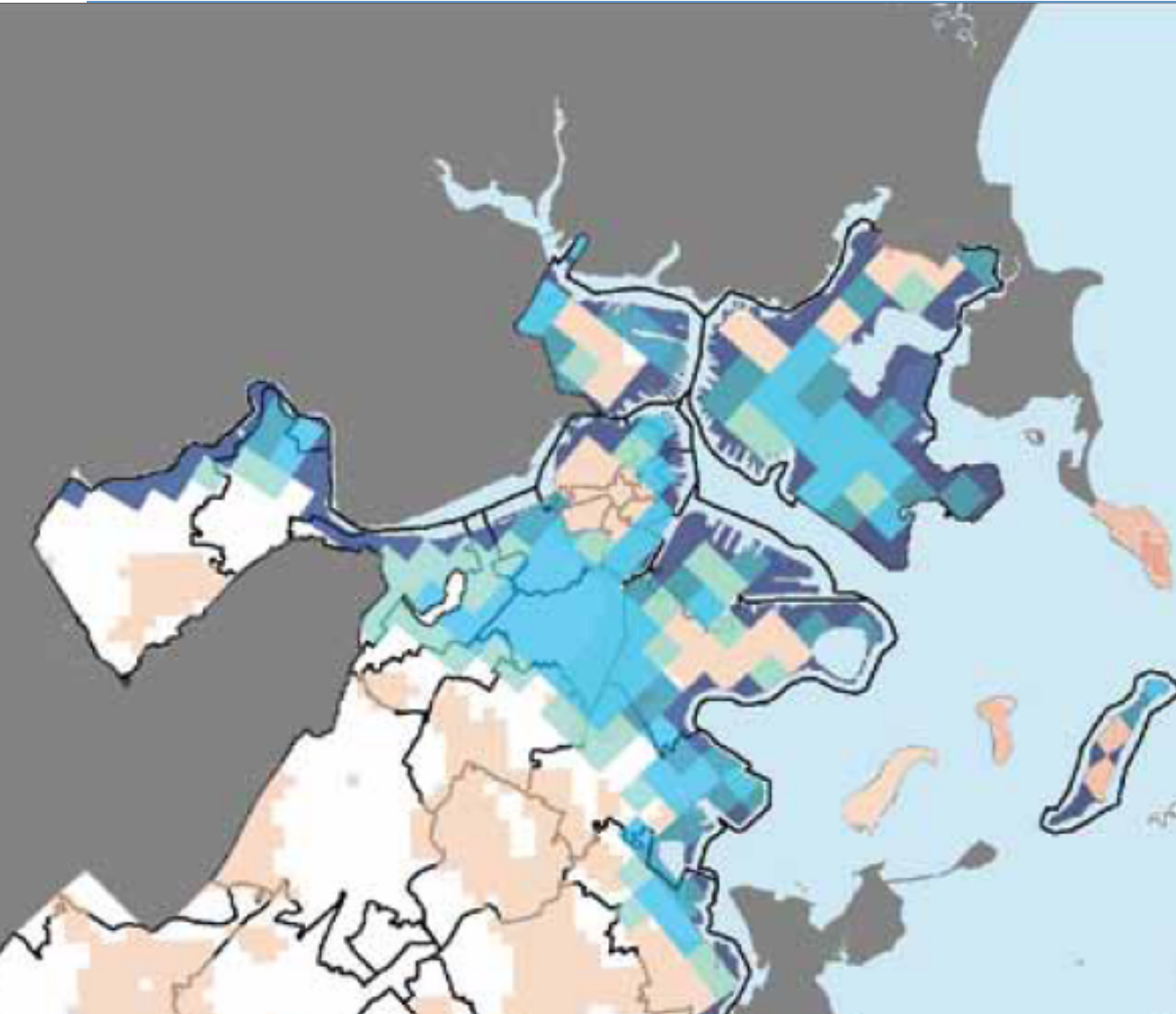
- Critical Infrastructure Systems
  - Water and Wastewater
  - Solid Waste
  - Energy
  - Communications
  - Transportation



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# Assess Vulnerabilities of Critical Assets to Multi-Hazard Conditions



***Flooding (blue color)  
combined with  
Wind Hazards  
(tan color) in  
Boston***

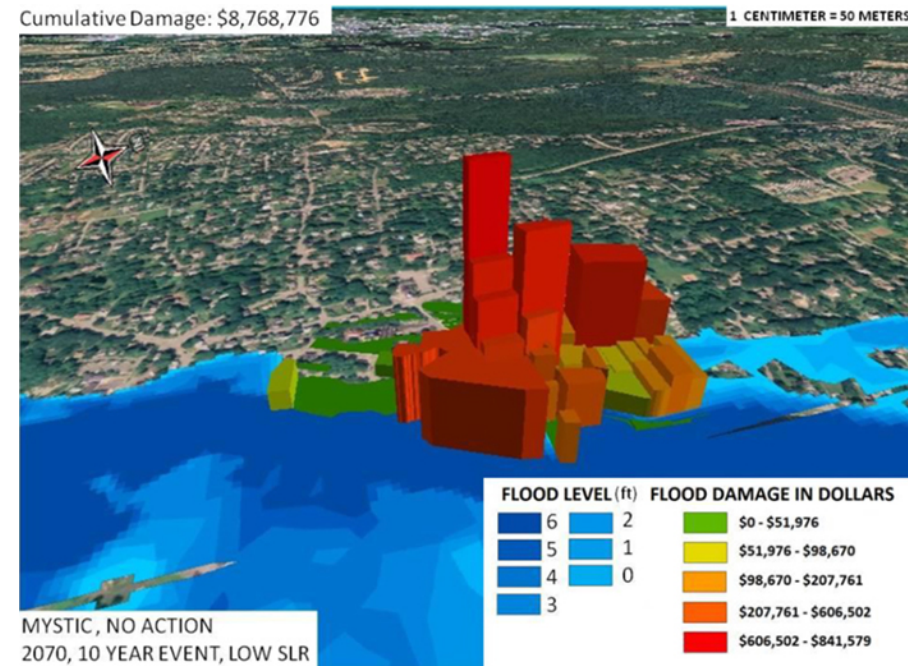
Source: *Building Resilience in Boston, 2013*



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# Vulnerability Assessment Resources

- State and Local Hazard Mitigation Plans
- Federal Agency Climate Adaptation Plans 2013
- USDOT, USEPA - Analysis of Vulnerability of Assets from Climate Change Impacts
- Local Business Continuity Planning

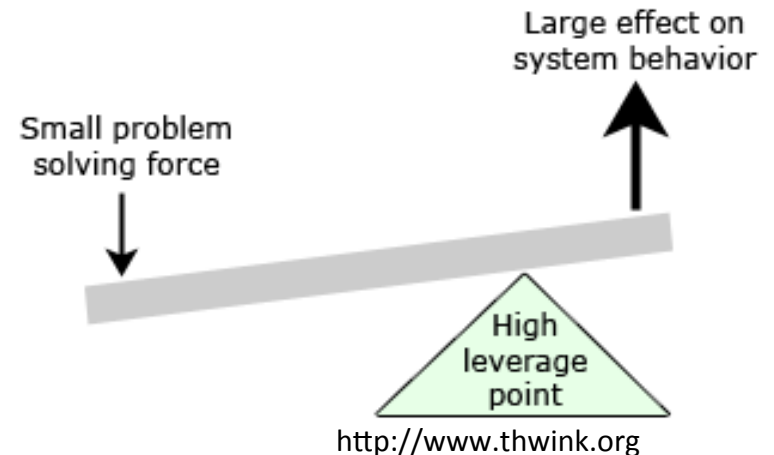


Flood Damage (Projected) in Groton, CT  
Source: <http://www.gis.fhwa.dot.gov>

# Identify Intervention Points, Strategies, Solution Sets

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- Planning and Coordination at Multiple Scales
  - Building → Town → Region
- Types of Assets
  - New Construction
  - Existing Facilities
- Levers
  - Land Use Planning
  - Codes and Standards
  - Inspection and Enforcement
  - Training





# Municipal Strategies

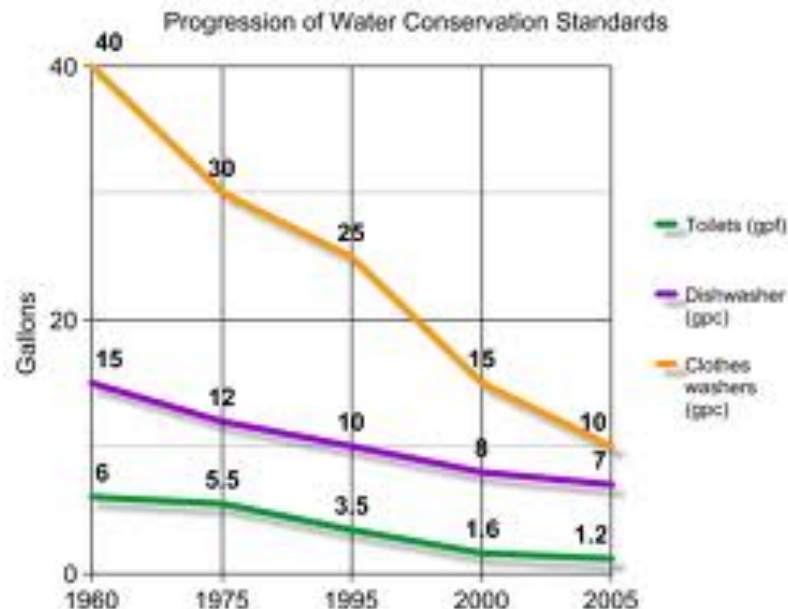
- Mandatory Building Retrofits
  - Energy/Water Conservation in Chico, CA
- Mandatory for New Construction or Major Retrofits
  - Elevate Buildings or Equipment in MD
- Incentives for Voluntary Actions
  - Transfer of Development Rights in Raynham, MA
- Financing Mechanisms for Voluntary Actions
  - Wind Resistance Retrofits in FL
- Education and Outreach
  - Extreme Heat Alert Program in Toronto, ONT

*Dekalb County's Inefficient Plumbing Fixture Replacement Plan went into effect in 2008 and requires that pre-1993 toilets, showerheads, and other plumbing fixtures be replaced when a property is sold.*



# Strategies at Multiple Scales

- Upgrade Systems and Components to
  - Eliminate Waste
  - Increase Efficiency



- Water leaks equal over 1 trillion gallons/yr
- Energy generation, distribution, and usage waste may equal 40-60%



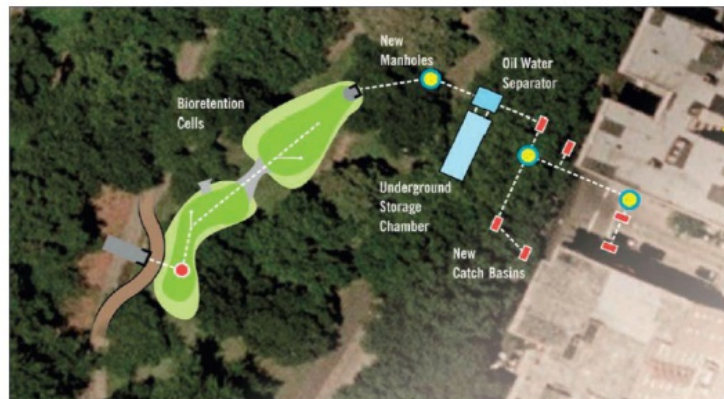
# Strategies at Multiple Scales

- Implement Soft/Green Infrastructure
  - Manage stormwater
  - Mitigate urban flood zones
  - Manage storm surge
- Stabilize Slopes and Inclines
- Coordinate with Community Groups



Low Density Residential Street:  
Post-Construction Enhanced Tree

GREEN INFRASTRUCTURE



GREEN INFRASTRUCTURE PLAN

“Green Infrastructure not only provides stormwater management but also flood mitigation, air quality management, and much more” ( EPA)





# Strategies For Buildings: Reduce Load

- Shade Building, Equipment, and Site
- Add Cool Surfaces (Site, Roof, Walls)
- Use Natural Ventilation
- Use Natural Lighting
- Widen Operations Settings



Evotranspiration and shading together can reduce air temperatures by 9 degrees F, and reduce air-conditioning costs by 40%. (p. 38)

Shade air conditioner condenser and other cooling units



# Strategies For Buildings: Enhance On-Site Services

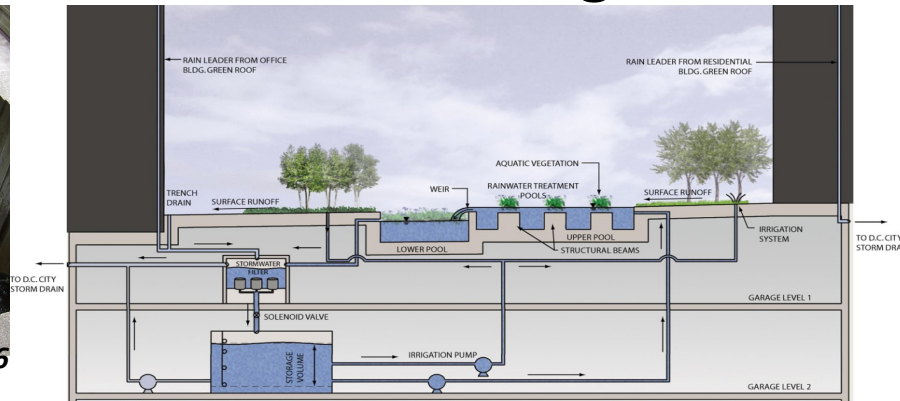
- Capture/Use Stormwater
- Develop Backup Power and Communications Systems
- Generate On-Site Renewable Energy
- Capture/Use Waste Energy
- Establish Emergency Plans, Communications, and Training

“Because co-generation and solar power systems are always in use, they can be more reliable than generators that are only turned on during emergencies.”

*NYC Building Resiliency Task Force, p. 84*



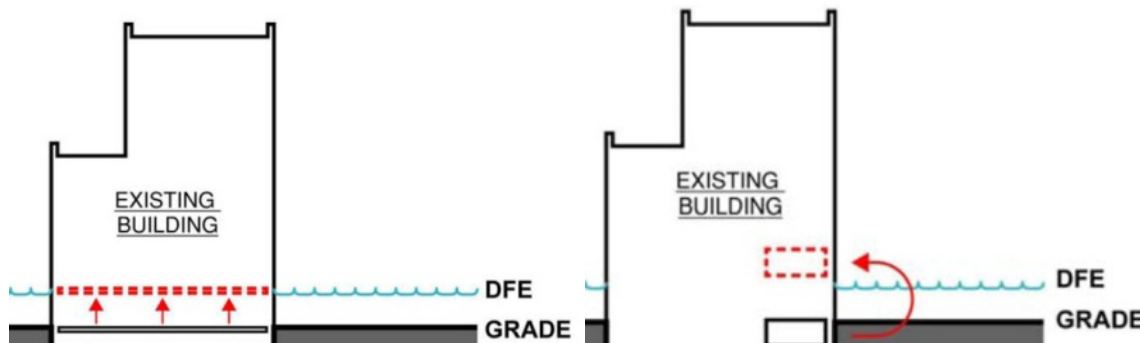
*Freeway Park, Seattle WA 1976*



# Strategies For Buildings: Relocate and Protect

- Storm-proof Structure and Enclosure
- Equipment and systems above Design Flood Elevation
- Permanent or temporary flood walls
- Backup lighting and communications
- Secure Equipment
- Record and Inventory Protection

Many existing buildings located in flood zones have adjacent street grades with elevations below the Design Flood Elevation, with perimeter walls and egress doors at the property lines, presenting significant challenges to building owners.





# Call to Action

- Assess and Re-Assess Vulnerabilities Over Time
- Plan and Invest for Resilience and Sustainability in All Capital Investments
- Collaborate and Coordinate Community and Regional Planning



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# Resources

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- Strategies to Upgrade Existing Building in “*Building Resilience in Boston*” report
  - <http://builtenvironmentcoalition.org> or [http://www.greenribboncommission.org/downloads/Building\\_Resilience\\_in\\_Boston\\_SML.pdf](http://www.greenribboncommission.org/downloads/Building_Resilience_in_Boston_SML.pdf)
- Hurricane Flood Maps – NOAA
  - <http://www.nhc.noaa.gov/surge/slosh.php>
- FEMA, *Mitigation Ideas* (2013)
  - [http://www.fema.gov/media-library-data/20130726-1904-25045-2423/fema\\_mitigation\\_ideas\\_final\\_01252013.pdf](http://www.fema.gov/media-library-data/20130726-1904-25045-2423/fema_mitigation_ideas_final_01252013.pdf)
- Examples of State, Local Adaptation Plans – Georgetown Climate Center
  - <http://www.georgetownclimate.org/adaptation/state-and-local-plans>