

# Successfully Surviving the Flood



Date: October 31, 2001

Federal Triangle  
Stormwater Study Working  
Group

Paul Tertell, PE



**Homeland  
Security**

# FEMA's Mission—Part of the Team

“...to support our citizens and first responders to ensure that as a nation we work together to build, sustain, and improve our capability to prepare for, protect against, respond to, recover from, and mitigate all hazards.”



# Historical Flooding – June, 2006

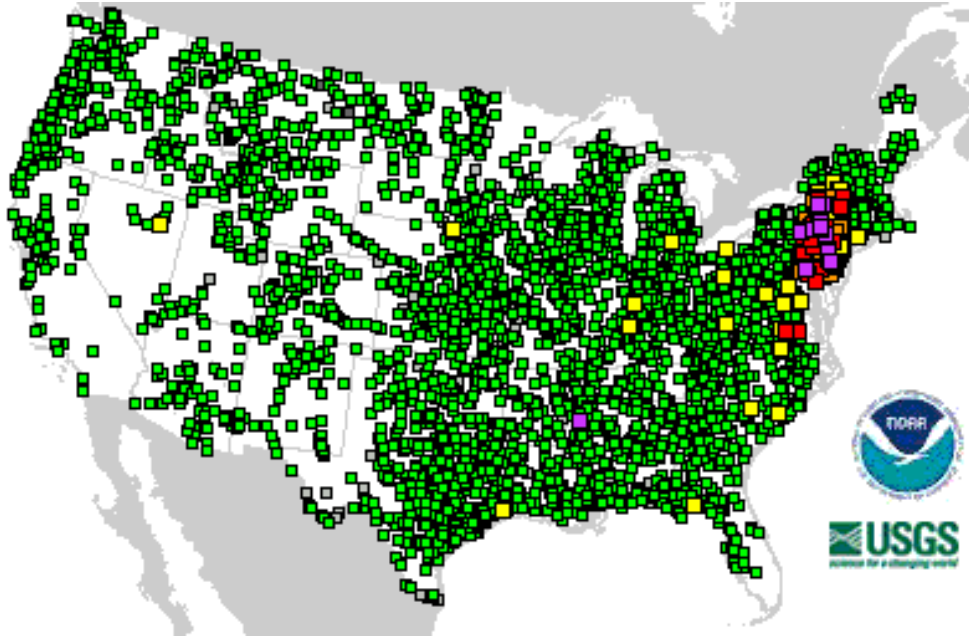
- June 19 wet weather pattern starts
- Tropical downpours June 25<sup>th</sup> -27<sup>th</sup>
- Accumulation of 7.09 inches on June 25<sup>th</sup>.
- Flooding shuts down operations of federal agencies in the Federal Triangle
  - IRS Headquarters
  - The Commerce Department
  - The Justice Department
  - The National Archives



Effects of flooding on 9<sup>th</sup> Street, NW in downtown Washington DC in June 2006

Source: NCPC Report on Flooding and Stormwater in DC

# Historical Flooding – June, 2006



River flooding in the United States, June 29, 2006

- Sections of Beach Drive, in Rock Creek Park, were washed out.
- Road closed for several months for repair/reinforcing. Beach Drive is main north-south road through park and major commuter artery.
- Mayor declared a state of emergency as a result of the flooding and the threat of power outages and other problems.



# Historic Flooding – 1936 & 1942



Washington Navy Yard during the October 1942 Flood

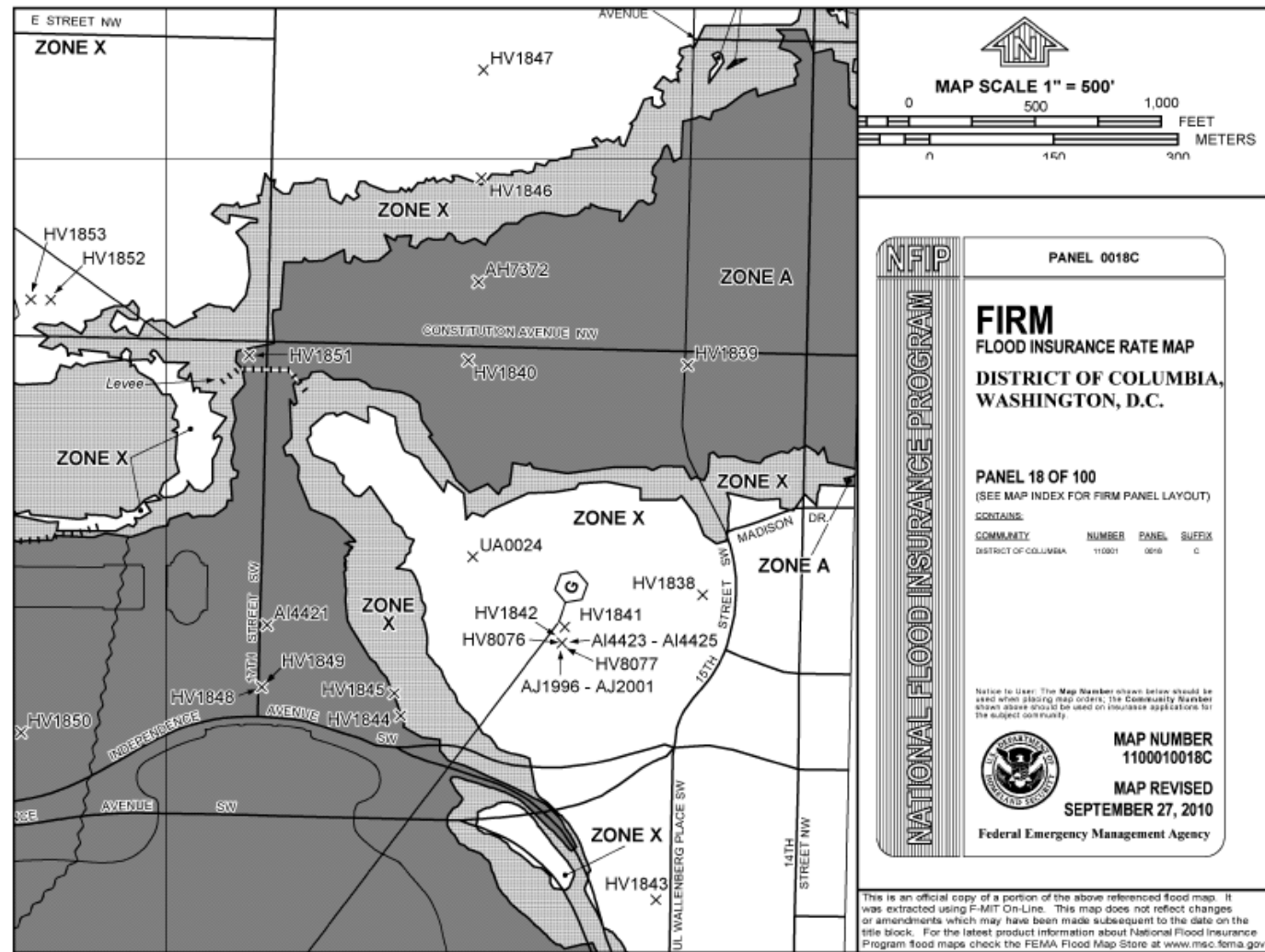
Photo # NH 90687 The Washington Navy Yard during the 1936 Potomac River flood



Washington Navy Yard during the 1936 Flood

# Flood Insurance Rate Maps – Identifying Risks

- Assesses risk based on flood zone delineations.
- Last revised for Washington DC in 2010.



# Vulnerabilities

- Vulnerability Assessments –what could go wrong
- Design Event
  - Building Codes and Regulations are minimums
  - Don't assume minimum requirements will meet your needs
- Assessment
  - Assess all hazards
  - Part of Facility Condition Assessment
  - Use a system that will justify funding or other action
- Resources
  - FEMA 424 – Design Guide for Multiple Hazards
  - FEMA 259 – Retrofitting Flood prone Structures
  - FEMA 551 – Selecting Appropriate Mitigations Measures
  - Full list of FEMA Floodplain Management Pubs: <http://www.fema.gov/plan/prevent/floodplain/publications.shtm>

# Building Codes

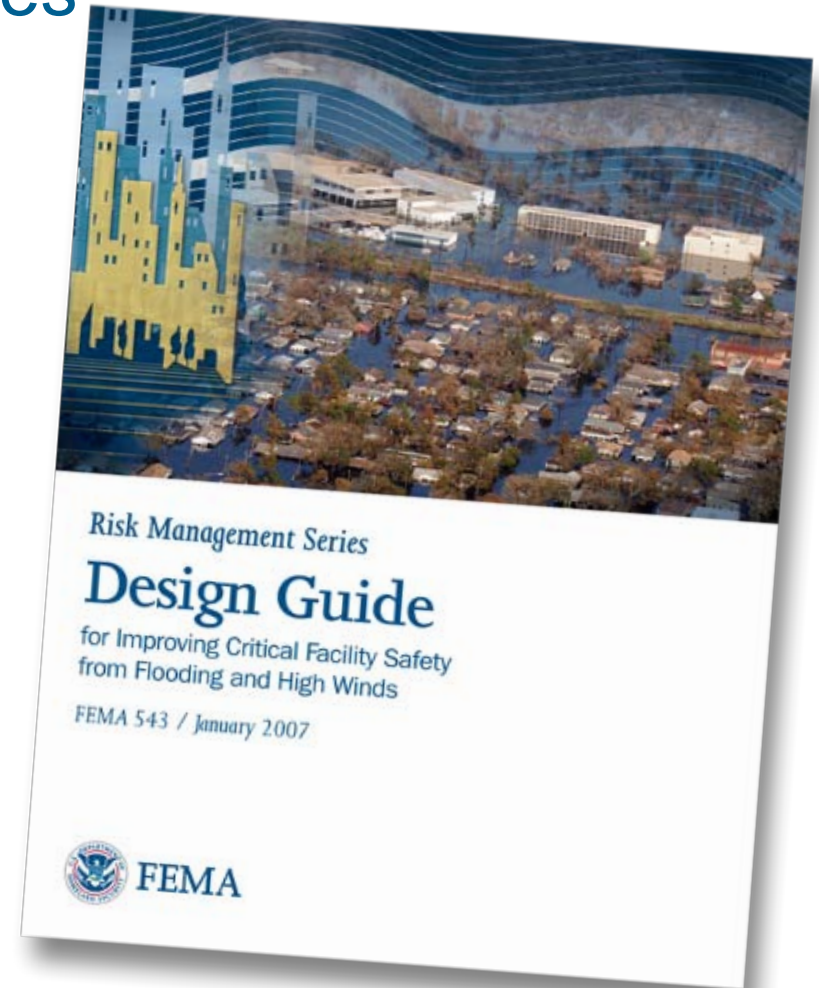
- Code compliance does not mean facilities will be undamaged or operating
- Codes address safety and limit damage
- Identifying other requirements for your building is your responsibility
- Examples of model building codes include:
  - *International Building Code (IBC), (ICC 2012a)*
  - *International Residential Code for One- and Two-Family Dwellings (IRC), (ICC 2012b)*
  - *International Existing Building Code (IEBC) (ICC 2012c)*
- Standards related to design/construction practices incorporated into codes by reference
  - *ASCE 7 and ASCE 24 is a reference standard for both the IBC and IRC*



# Design and Vulnerability Assessment Guides

## FEMA Critical Facility Design Guides

- FEMA 543 – Critical Facilities
- FEMA 577 – Hospitals



# Tools for Buying Down Risk

- Hazard Identification and Quantification
- Vulnerability Assessments
- Risk Assessments
- Probable Maximum Loss Reports



# Flood Damages and Sources of Flooding

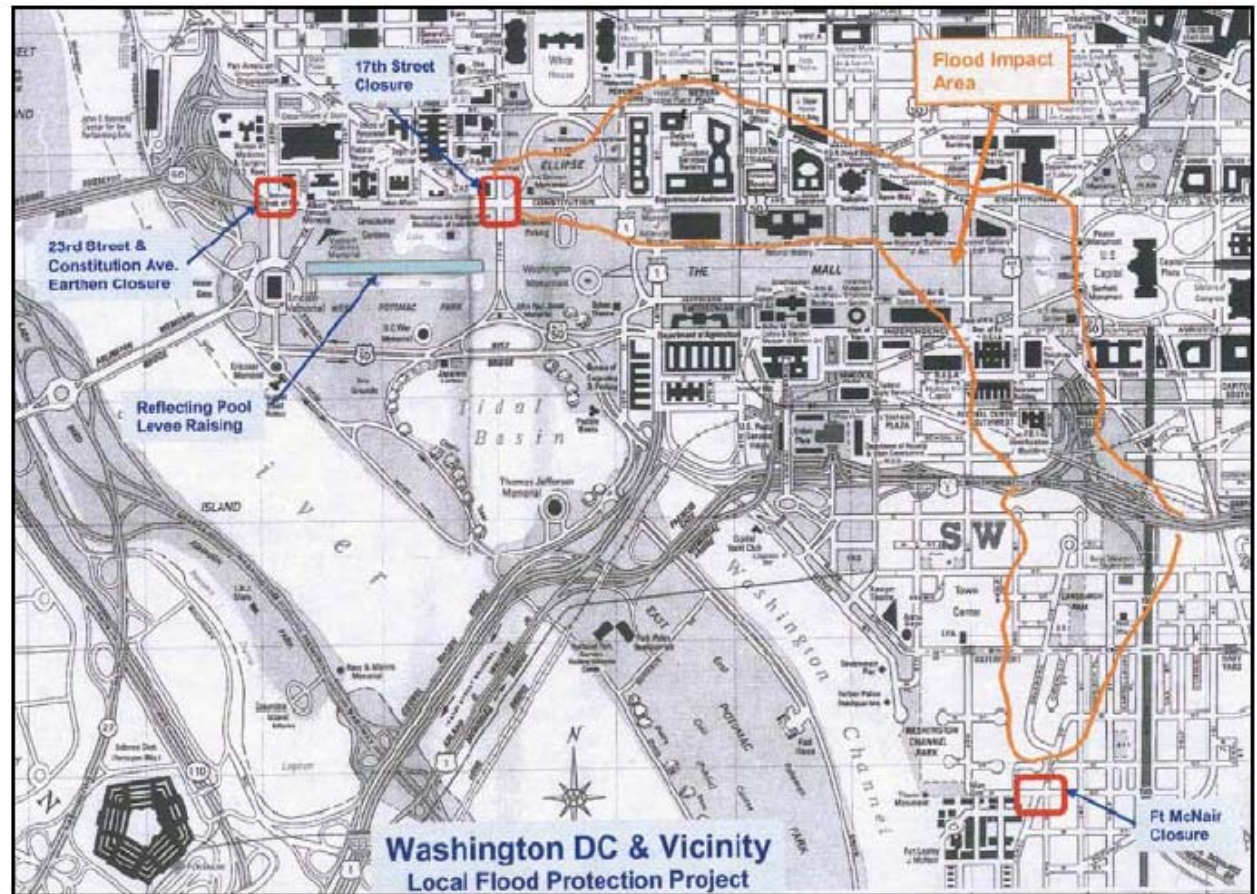
- Direct damage from:
  - Inundation
  - Sedimentation
  - Flood-borne Debris/Flood Velocity
- Sources of flooding
  - Storm surge
  - Broken water mains/pipes
  - Storm water drainage, flow along old creek beds
  - Riverine flooding and others
  - Where can your flooding come from?





# Types of Flood Damages

- June 2006 Flooding: Flood impact area and street closures
- Washington DC is particularly susceptible to overbank flooding in Potomac Park, along the Tidal Basin and over the National Mall area up to the Reflecting Pool.
  - These Areas have the lowest elevations in DC.



Source: NCPD Report on Flooding and Storm water in DC



# Tropical Storm Allison: Flooding in Houston Downtown



# Tropical Storm Allison: Flooding in Houston Downtown



# Types of Flood Damages

- Degradation of building materials and equipment due to exposure to flooding



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# Types of Flood Damages

Building contamination due to flood-borne substance or mold



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# Flood Design Strategies

- Any flood damage will be minor and easily repairable
- Foundation will remain intact following a design flood
- Building envelope will remain sound
- Utility connections will remain intact or easily restorable after a flood
- Building will be accessible and usable after a design flood

# Flood Hazard Vulnerabilities -Example

<p>Are any building spaces below-grade (basements)?</p>	<p>Below-grade spaces and their contents are most vulnerable to flooding and local drainage problems. Rapid pump out of below-grade spaces can unbalance forces if the surrounding soil is saturated, leading to structural failure. If below-grade spaces are intended to be dry floodproofed, the design must account for buoyant forces.</p>
<p>Are any critical building functions occupying space that is below the elevation of the 500-year flood or the Design Flood Elevation?</p> <p>Can critical functions be relocated to upper levels that are above predicted flood elevations?</p> <p>If critical functions cannot be relocated, is floodproofing feasible?</p> <p>If critical functions must continue during a flood event, have power, supplies, and access issues been addressed?</p>	<p>New critical facilities built in flood hazard areas should not have any functions occupying flood-prone spaces (other than parking, building access and limited storage).</p> <p>Existing facilities in floodplains should be examined carefully to identify the best options for protecting functionality and the structure itself.</p>





# To Obtain FEMA Publications...

Call the FEMA warehouse (1-800-480-2520)

Request publication by number:

**FEMA 543** Design Guide for Improving Critical Facility  
Safety from Floods and High Winds

