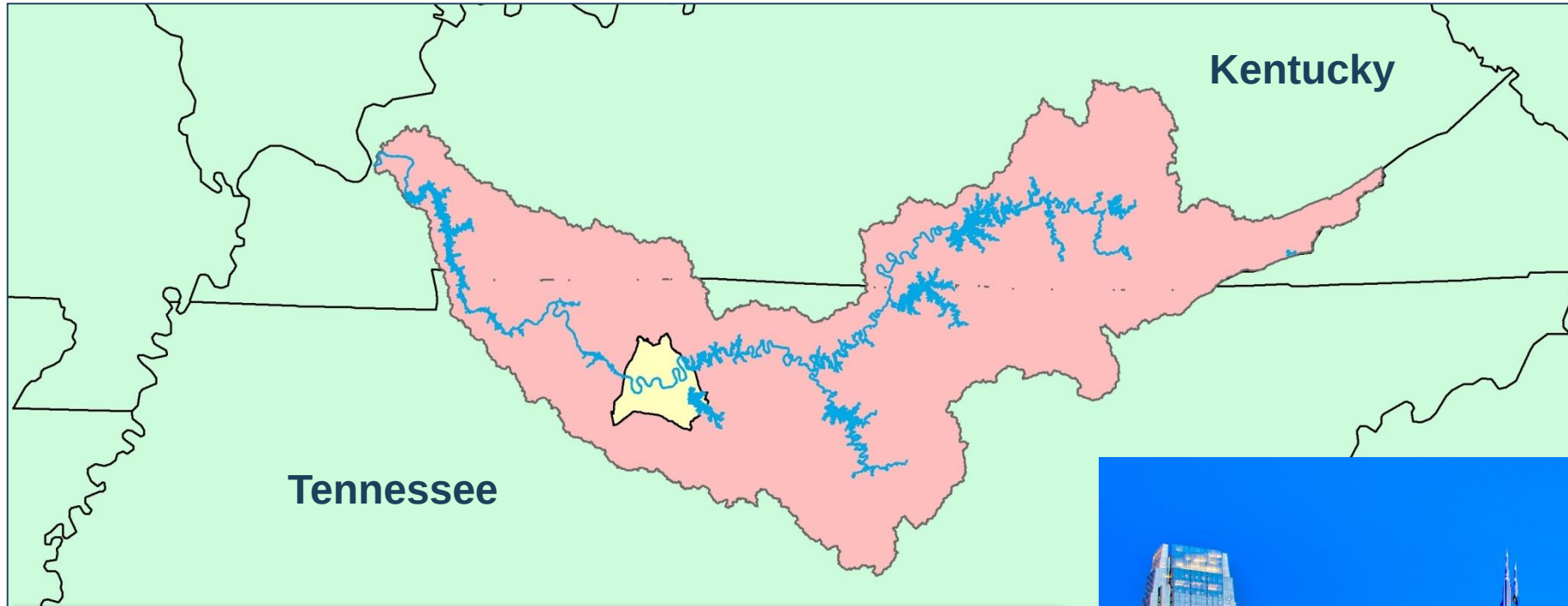




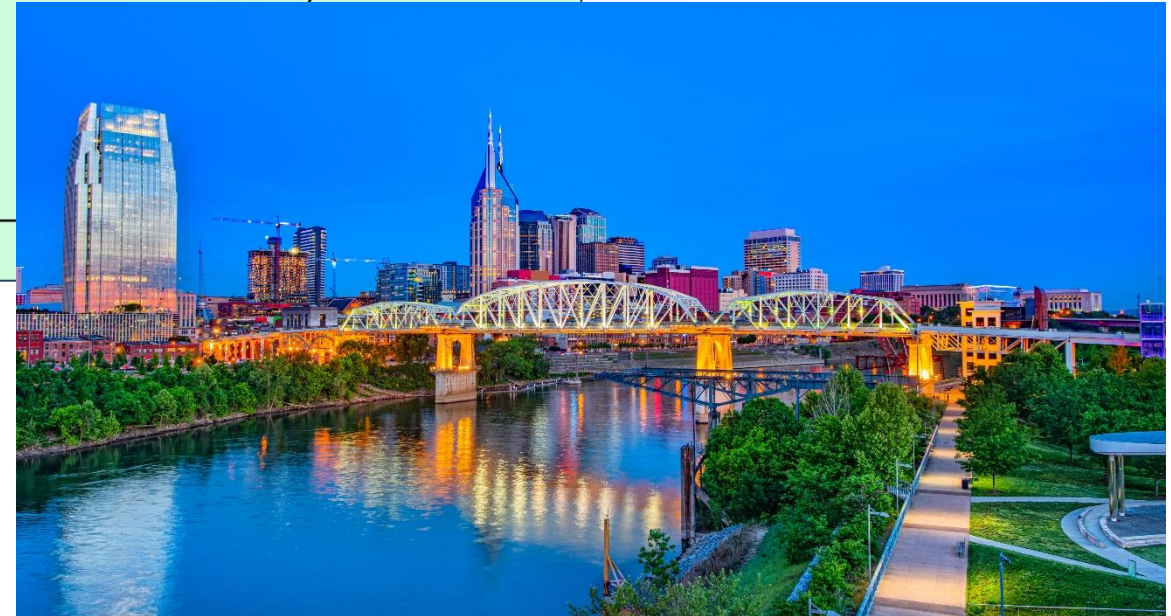
Nashville Flood of Record A 10-year Retrospective Byron Hinchey, PE, CFM



Cumberland River



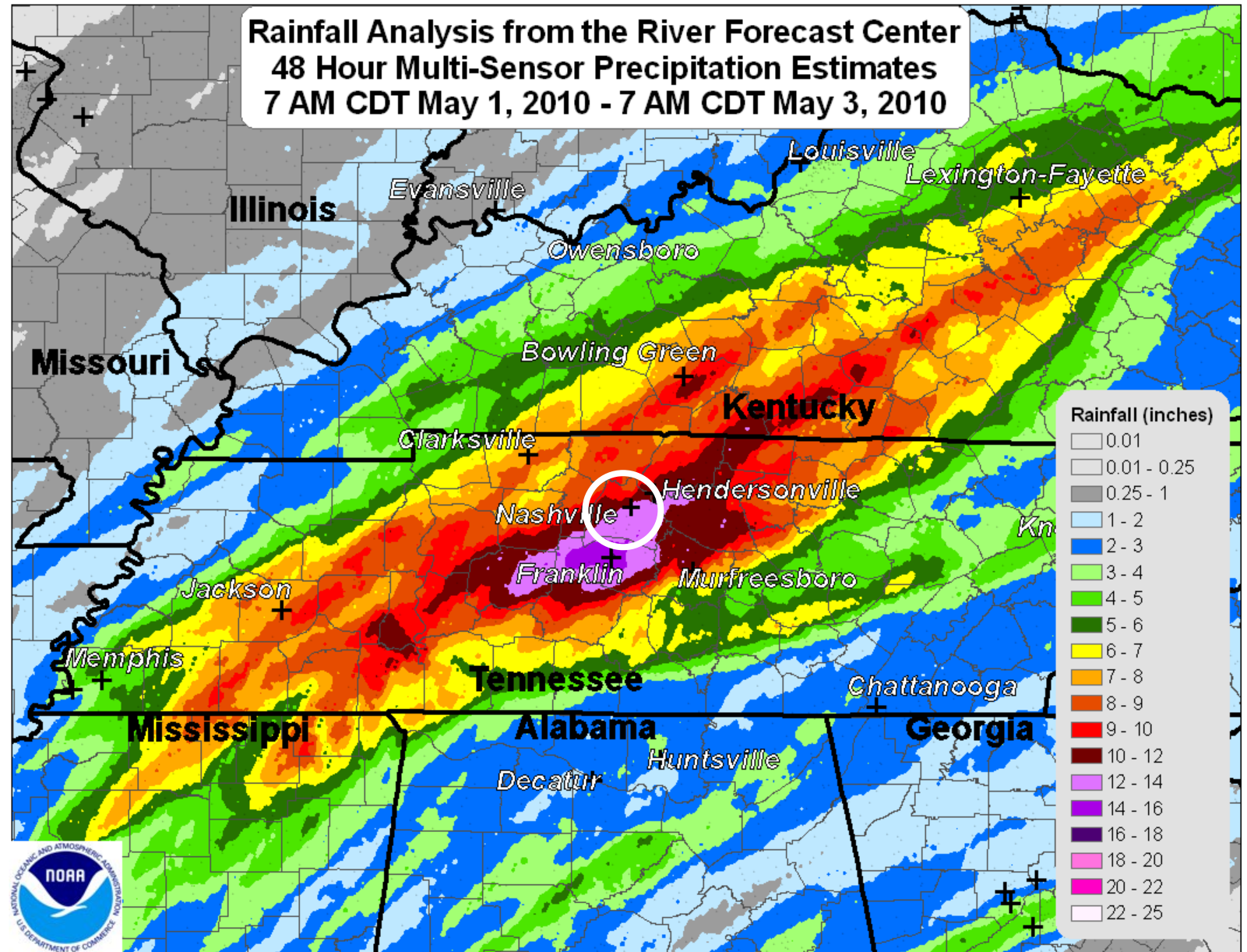
12,860 mi² Drainage Area in Nashville



May 1&2, 2010

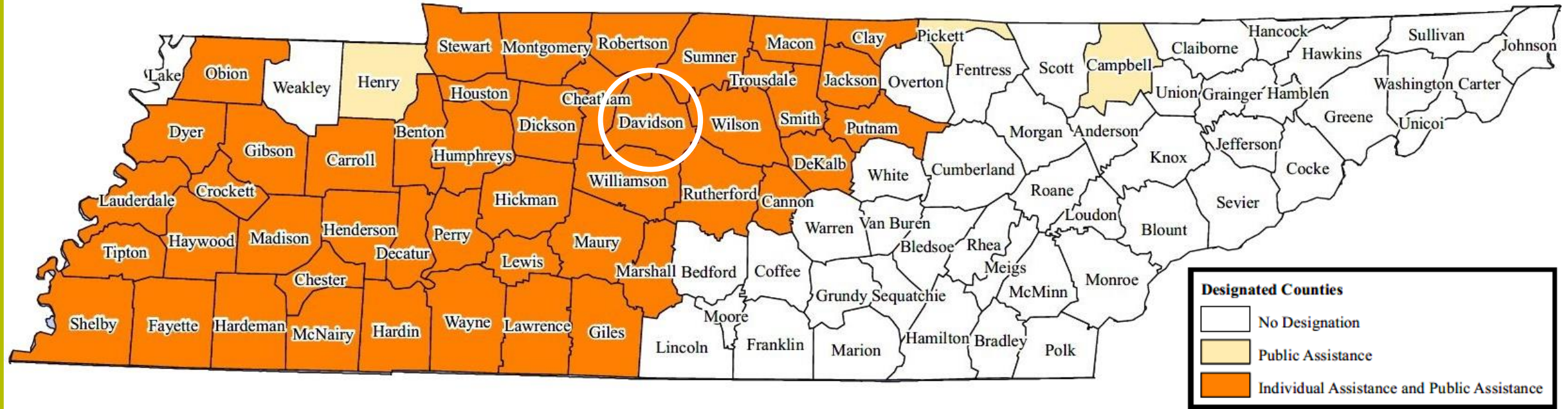
It Rained a Little

13-18 in.
48 hours



DR-1909

\$3.5 Billion in Flood Damages



- ❖ Public Assistance (49 counties) \$228.9 million
- ❖ Individual Assistance (30,169 applications) \$169.3 million
- ❖ HMGP (64 applications) \$64.9 million

Residential

14,000
Homes Flooded



Harpeth River
8 feet Above
Flood Elevation

Above 500-yr Flood Elevation!

Commercial / Industrial



Transportation



Interstate Highways

- ❖ 3 Interstates Shut Down (I-24, I-40, and I-65)
- ❖ I-40 Between Nashville and Memphis Shut Down for Days



Opryland Hotel

❖ Opryland Hotel Complex Protected by Levee...1 foot too low



Opryland Hotel

\$220 million in Damages | 1700 Staff Laid Off | 6 Months to Reopen



REOstone Quarry

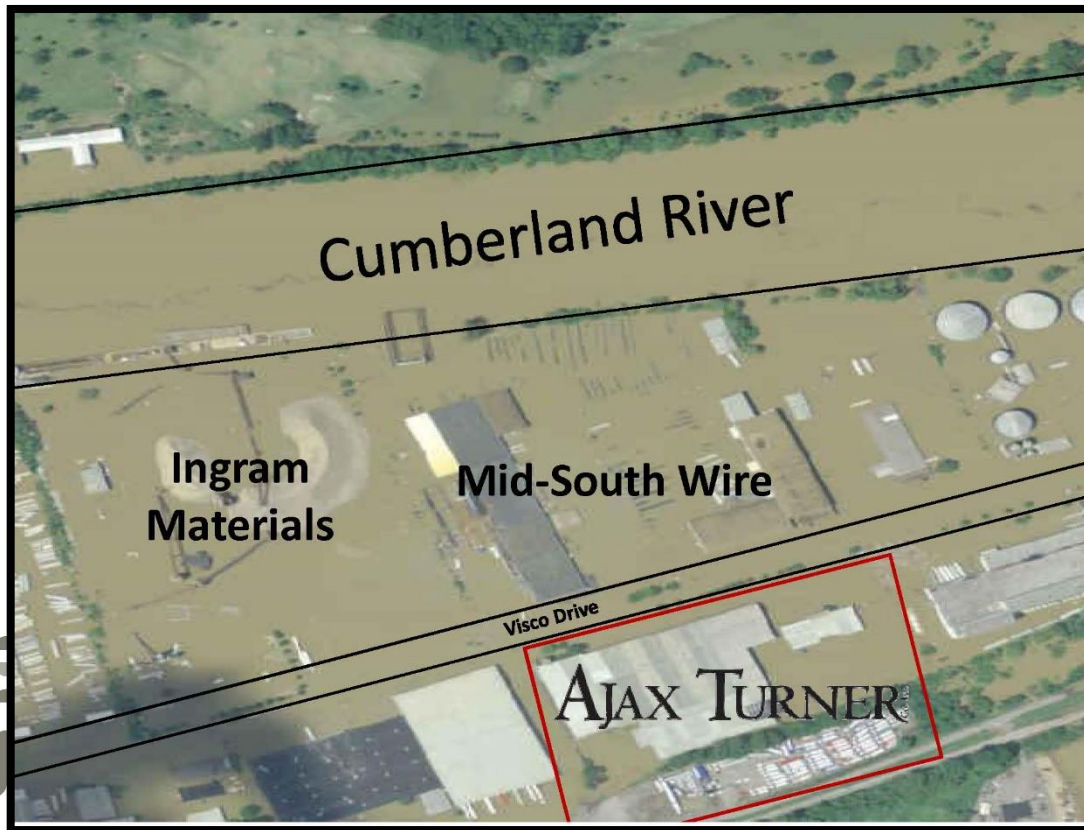
- ❖ 300 feet deep
- ❖ 21,000 Acre-Feet
- ❖ 8 hours to Fill & 9 Months to Drain



Ajax Turner (Anheuser-Busch Distributor)

Typical Industry along
the Cumberland River

Lead Time Allowed Fleet to Move



Ajax Turner

- ❖ Consumable Goods Exposed to Floodwaters... **Must be Destroyed!**

All Keg Beer

40-Days of Supply

400,000 Cases



Nissan Stadium (Tennessee Titans)

- ❖ Electric Sub-station Powered Down
- ❖ Stadium Pumps Couldn't Run
- ❖ > \$2M in Damages



Widespread Media Omission

Nashville Lost in the Shuffle



CNN – Stories That Matter 2010



Mar 23

Obama signs health care bill

Apr 10

Polish president killed in plane crash

Apr 23

Immigration law enacted in Arizona

May 1

Car bomb found in Times Square

Jun 1

● → **Nashville Under Water**

Van der Sloot arrested in Peru

Jun 23

U.S. general resigns



WSJ – Top 10 News Stories of 2010

Jan 12	Earthquake in Haiti
Mar 23	Obama Signs Health Care Bill
Apr 14	Iceland's Eyjafjallajokull Volcano Erupts
Apr 20	Deepwater Horizon Accident
May 31	Israel Attacks Cargo Ships
Jul 11	First World Cup in Africa
Oct 14	Chile Rescues Trapped Miners
Nov 2	Republicans Take House
Nov 16	Prince William Gets Engaged
Nov 28	WikiLeaks reveals U.S. secrets

● → **Nashville Under Water**



Flood Response



Activate Emergency Operations Center (EOC)



Office of Emergency Management
Fire Department
Police Department
Sheriff's Department
Metro Water Services
Public Works
Health Department
Emergency Communications Center
Law Department
General Services
Information Technology Services
Planning Department
Parks Department
Human Resources Department
Finance Department
Nashville Public Schools
Transit Authority
Nashville Electric Service
Regional Hospital Coordinator
Hands on Nashville
American Red Cross
Nashville Humane Association

Rescue Efforts

❖ 11 People Died in Nashville

- 5 in Vehicles average age 69
- 4 at Home average age 80
- 1 “in flood water” age 21
- 1 “tubing” age 18

❖ 26 People Total Died in TN & KY



Aerial Photography



Initial Damage Assessment

- ❖ Codes Department - Windshield Survey
- ❖ Estimated Damage for 9100 Properties



Assessment of Substantial Damage

- ❖ Metro Water Services – Stormwater Division
- ❖ Substantial Damage Assessment - 4800 Properties



Cleanup Operations

- ❖ 60,000 tons of Debris
- Disposal Cost \$5 million



Critical Facilities Operational

- ❖ 2 Water Treatment Plants (45 mgd each)
 - Harrington went Offline
 - Omohundro Inaccessible
- ❖ 3 Wastewater Treatment Plants
 - Dry Creek Plant went Offline
 - Whites Creek Plant Damaged
 - Central Plant Damaged
- ❖ 28 Sewer Pump Stations Flooded
- ❖ Biosolids Facility Flooded
- ❖ Inspect/Clean Sewer Lines
 - 300 miles televised
 - 43 miles cleaned
 - 2500 tons debris removed



Repair Infrastructure

- ❖ Repair Roads (450) & Bridges (50)
- ❖ Repair Road Infrastructure (1,000)
- ❖ Remove Debris Fields (20)
- ❖ Repair Drainage Systems (700)



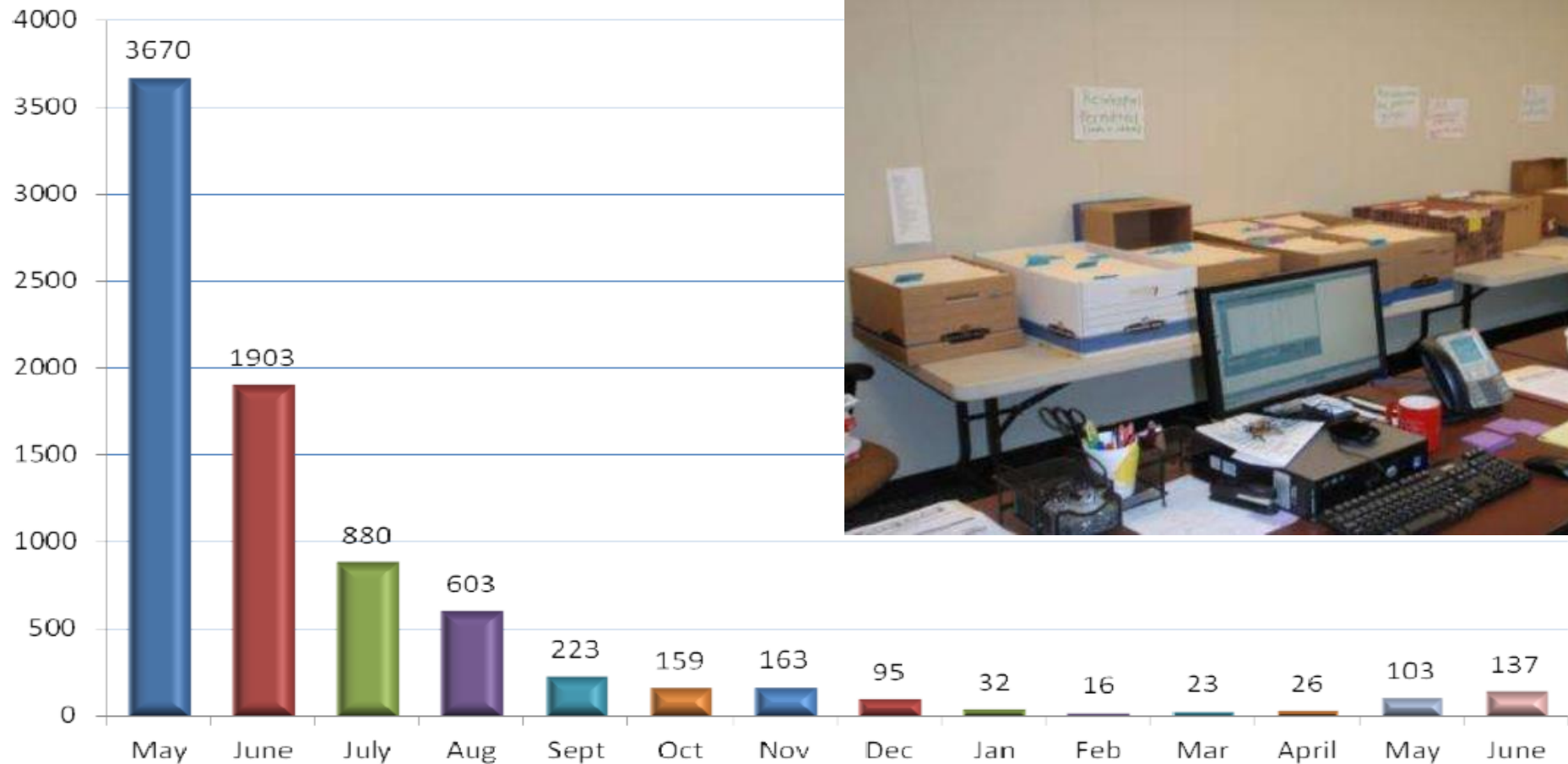
Riverbank Stabilization

- ❖ Cumberland River
- ❖ 2,300 feet Severe Bank Damage
- ❖ 35 Properties Affected



Review Building Permit Requests

❖ 6,000 Building Permits in First 90 Days



Move Toward Resiliency



After Action Reports



US Army Corps
of Engineers

After Action Report

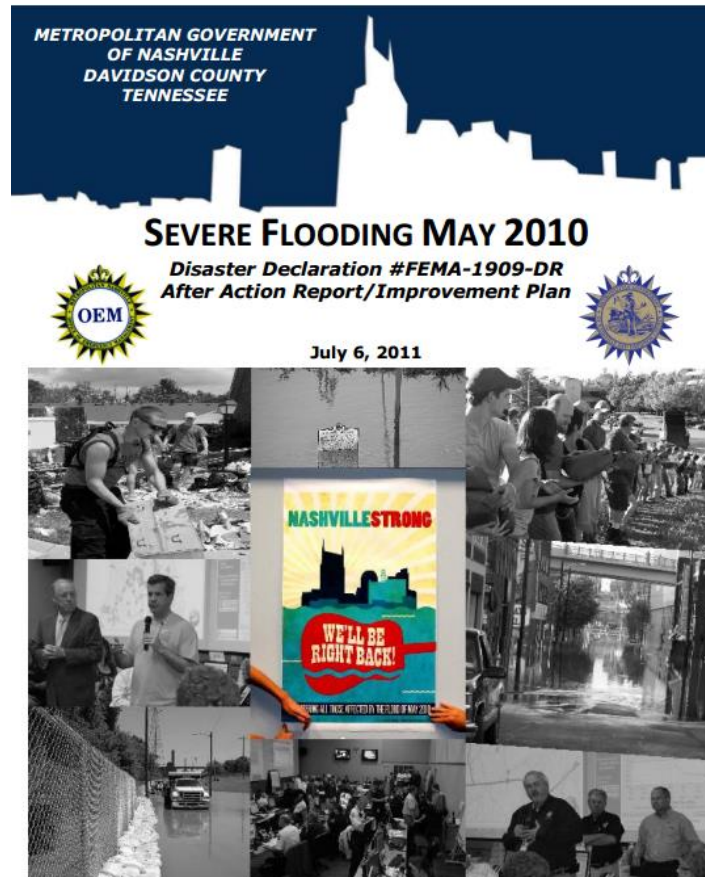
May 2010 Flood Event Cumberland River Basin

1-3 May 2010

Great Lakes and Ohio River Division



21 July 2010



Service Assessment

Record Floods of Greater Nashville: Including Flooding in
Middle Tennessee and Western Kentucky, May 1-4, 2010

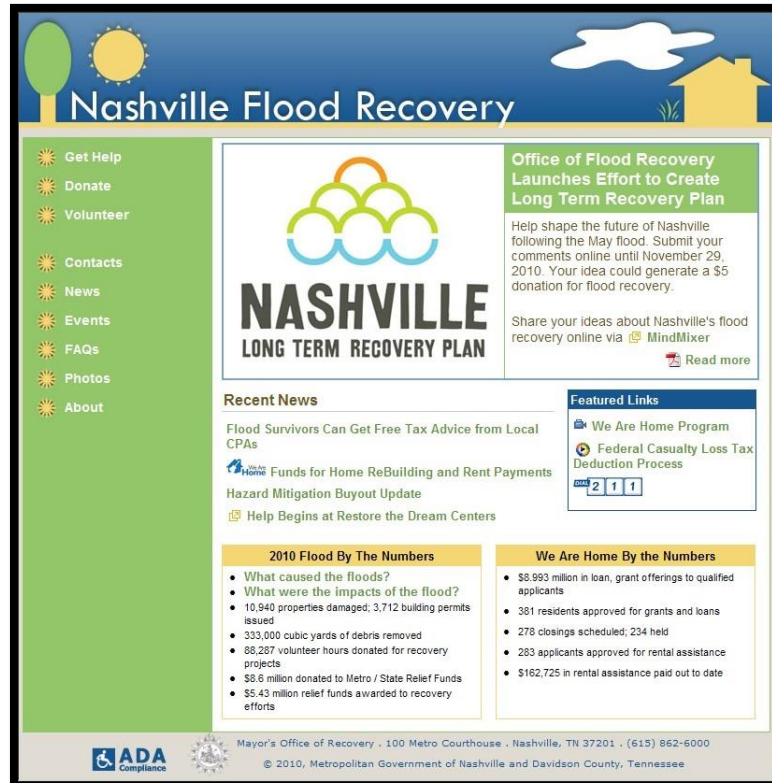


U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Weather Service
Silver Spring, Maryland

Long Term Community Recovery Plan

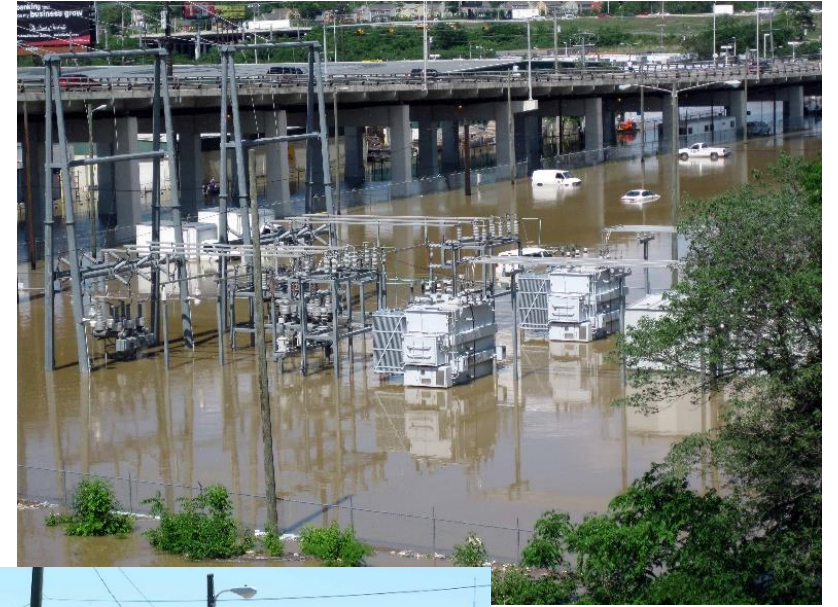
Pursuant to Stafford Act

Plan to guide the long term social, economic and environmental recovery efforts, and ensure proposed projects are sustainable and will mitigate the impact of future events.



Basic Steps to Improve Resiliency

1. Minimize Vulnerabilities of Critical Facilities
2. Implement Long-term Mitigation Plan
3. Better Predictive Tools
4. Better Flood Warning Capabilities
5. Better Communication & Collaboration



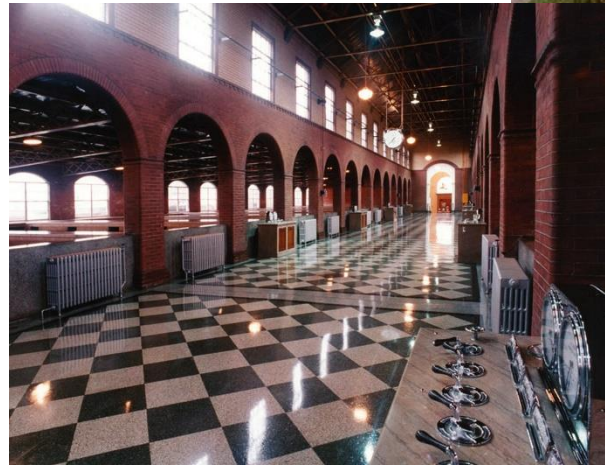
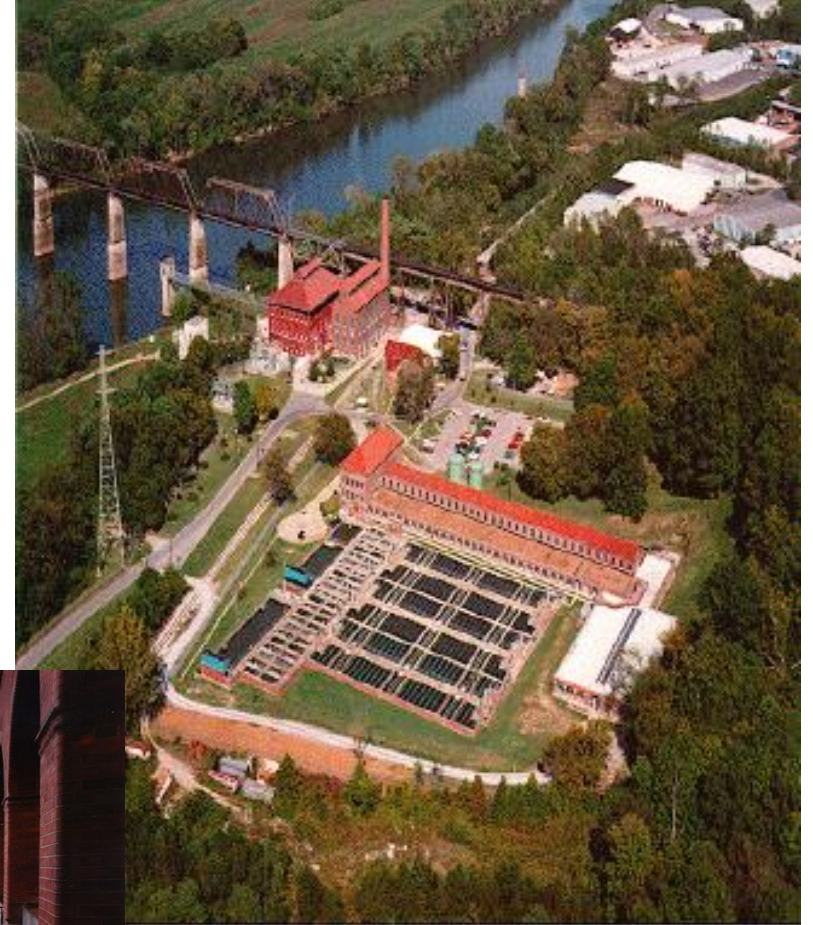
KR Harrington Water Treatment Plant

- ❖ Elevate or Protect to 500-yr Elevation + 2 feet
 - Chemical Feed Systems
 - Clear Well Vents
 - Switch Gear System
 - Raw Water Pumps (4 feet)
- ❖ Relocated Switch Gear System
- ❖ New Generator Building Raised 10 feet
- ❖ Add 5th Generator
- ❖ Floodwall



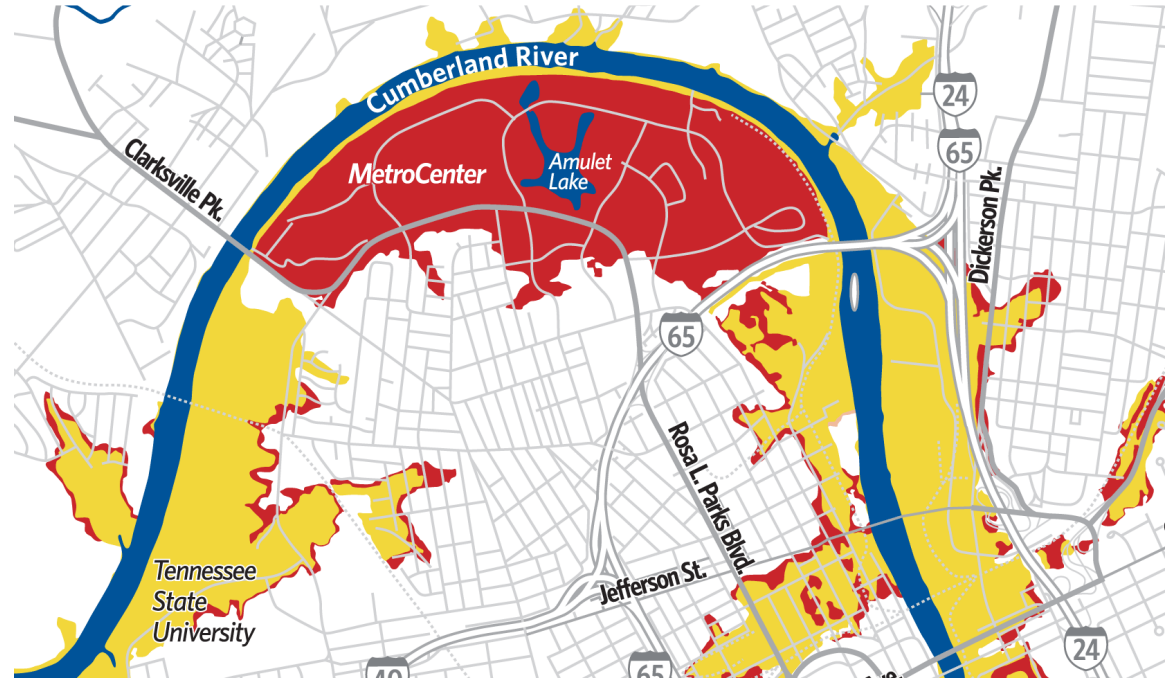
Omohundro Water Treatment Plant

- ❖ New Alternative Access Road
- ❖ Extend and Elevate Intakes
- ❖ Floodproof Pump Station Building
- ❖ New Generator Building
 - 4 Generators & 3 Diesel Tanks (75k gallons)
- ❖ Full Capacity (90 mgd) on Generators



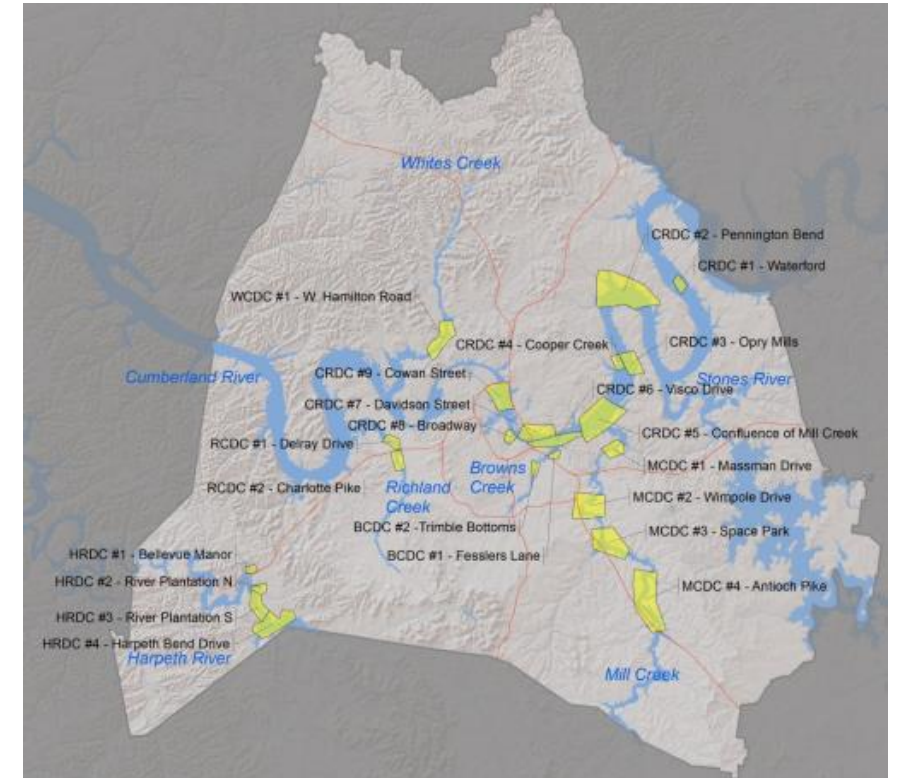
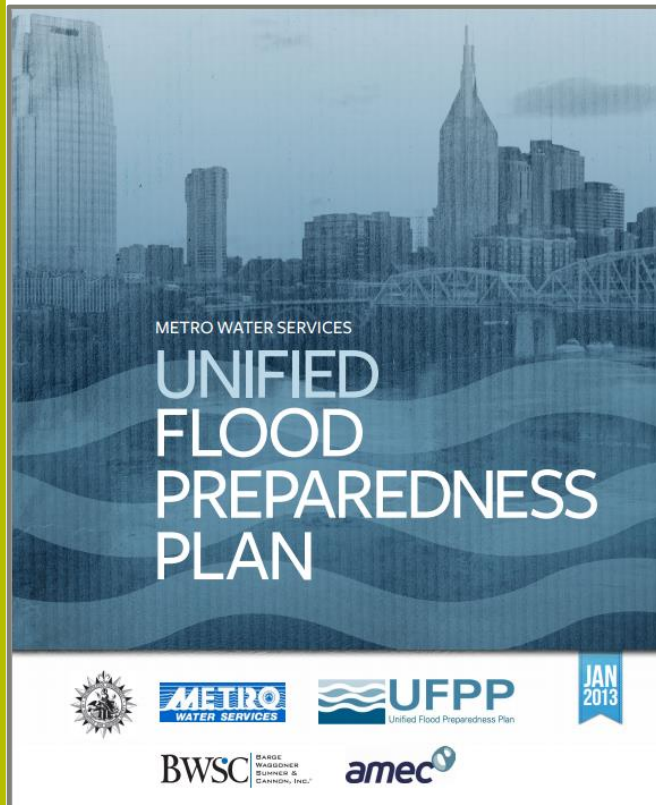
Metro Center Levee

- ❖ 1,000 acre Commercial/Industrial Development
 - 150 Companies with 10,000 Employees
- ❖ Raise Levee to 500-year Flood Level
- ❖ New Stormwater Pump Station
 - 4 Capable of Pumping 500-yr Rainfall Event



Unified Flood Preparedness Plan (UFPP)

❖ Evaluated Flood Mitigation Options for 22 Damage Centers



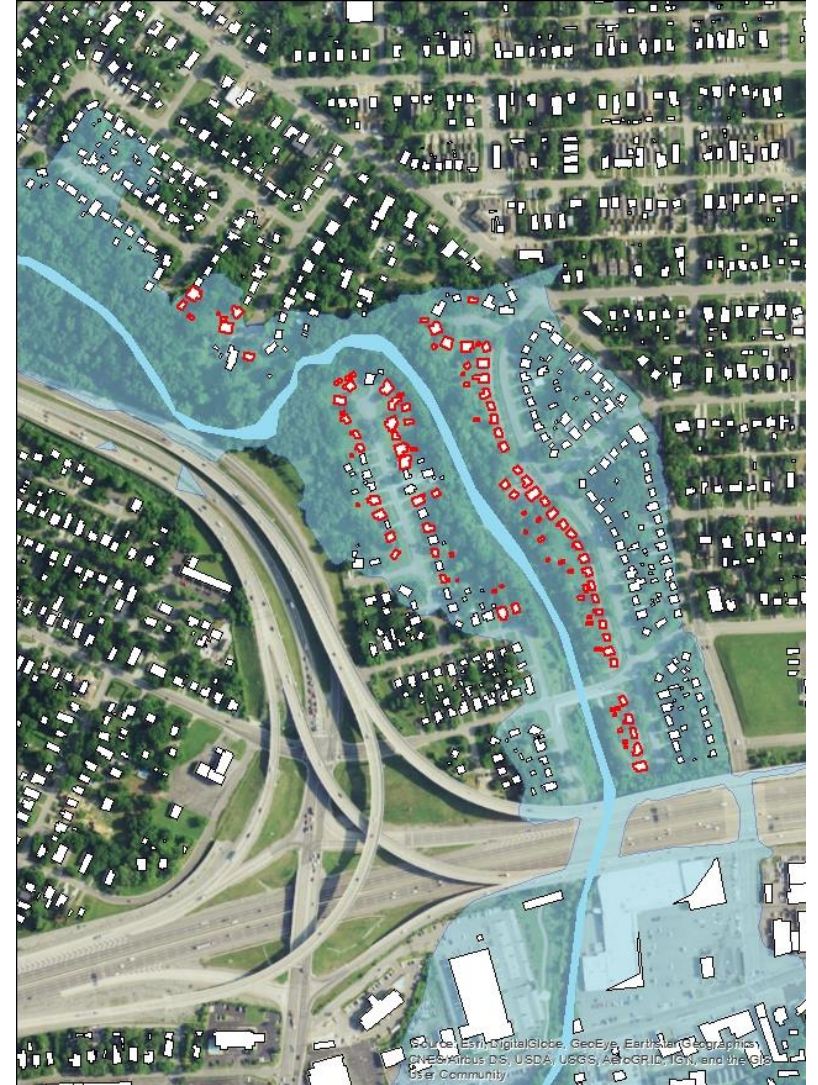
Downtown Floodwall

- ❖ 2,100 foot long flood wall
 - 900' permanent & 1200' removable
- ❖ Crest 2 feet Above 2010 Flood
- ❖ Cost \$125 million
 - \$65M in SW Pump Station



Hazard Mitigation Buyout Program

- ❖ Pre-2010 – 102 parcels bought
- ❖ Post-2010 – 286 parcels bought
 - Roughly 85% acceptance rate
- ❖ Total Investment \$44M
- ❖ Funding for Program
 - HMGP (75/25)
 - USACE (65/35)
 - Local
- ❖ More than 700 more Homes on “Wish List”



Nashville Situational Awareness for Flooding Events (SAFE)



US Army Corps
of Engineers

After Action Report

May 2010 Flood Event Cumberland River Basin

1-3 May 2010

Great Lakes and Ohio River Div



21 July 2010



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National Oceanic and Atmospheric Administration
National Weather Service
Silver Spring, Maryland

METROPOLITAN GOVERNMENT
OF NASHVILLE
DAVIDSON COUNTY
TENNESSEE

SEVERE FLOODING MAY 2010

Disaster Declaration #FEMA-1909-DR
After Action Report/Improvement Plan



July 6, 2011



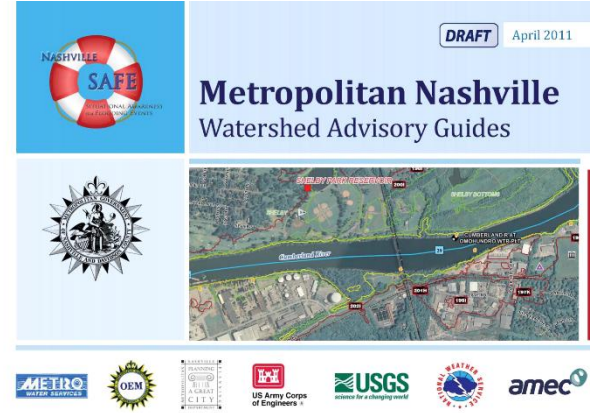
Nashville Situational Awareness for Flooding Events (SAFE)

- ❖ **Monitor** Actual and Forecasted River Stages
- ❖ **Acquire** Information that Can be Used to Dispatch Resources
- ❖ **Share** Information Between Local, State, and Federal Partners
- ❖ **Respond** more Efficiently to Flood-Related Emergencies

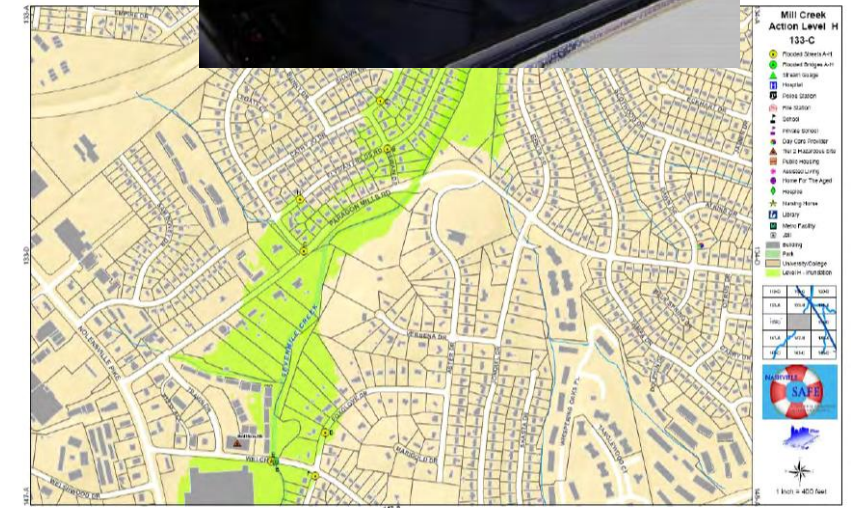


US Army Corps
of Engineers®



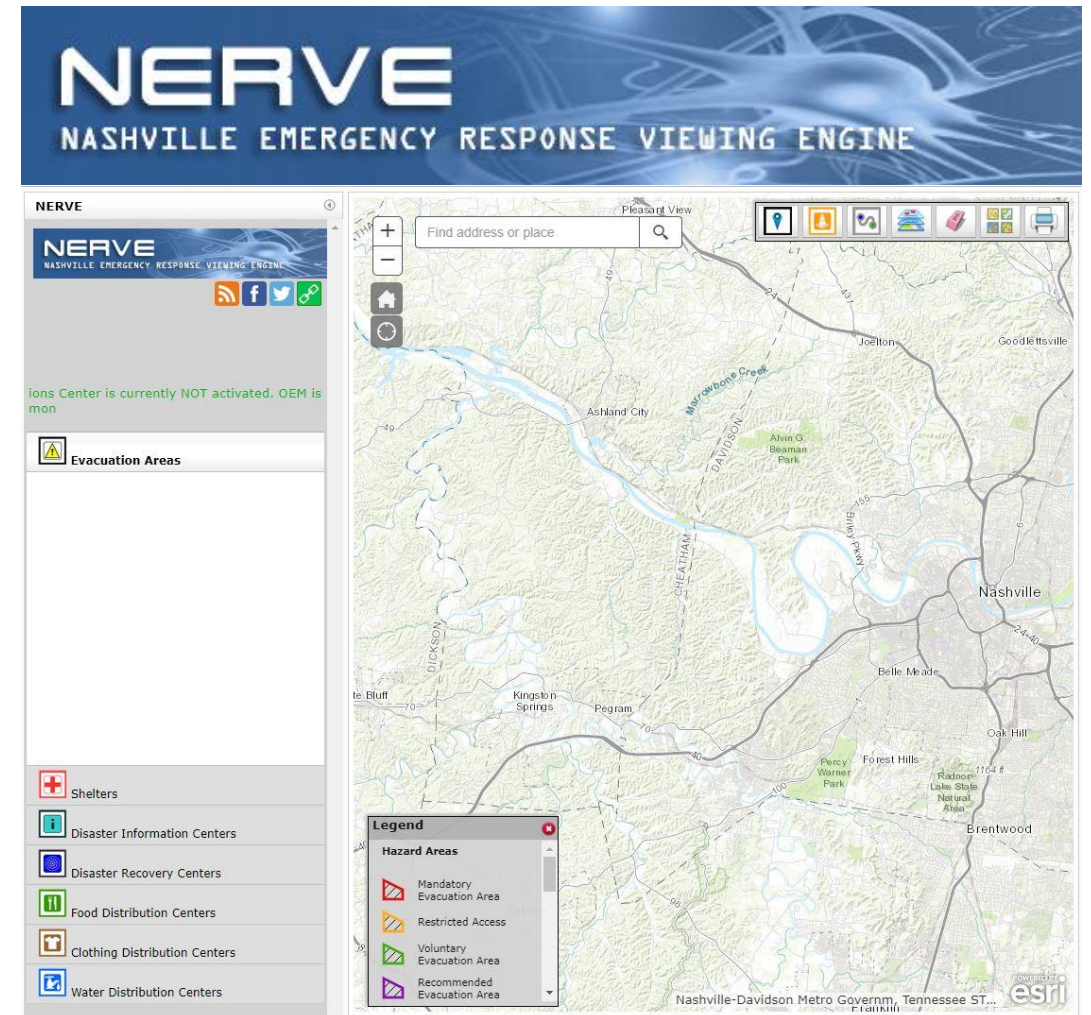


A police officer in a dark uniform with "POLICE" and "SHERIFF" patches is seated in the driver's seat of a vehicle, looking out the window.



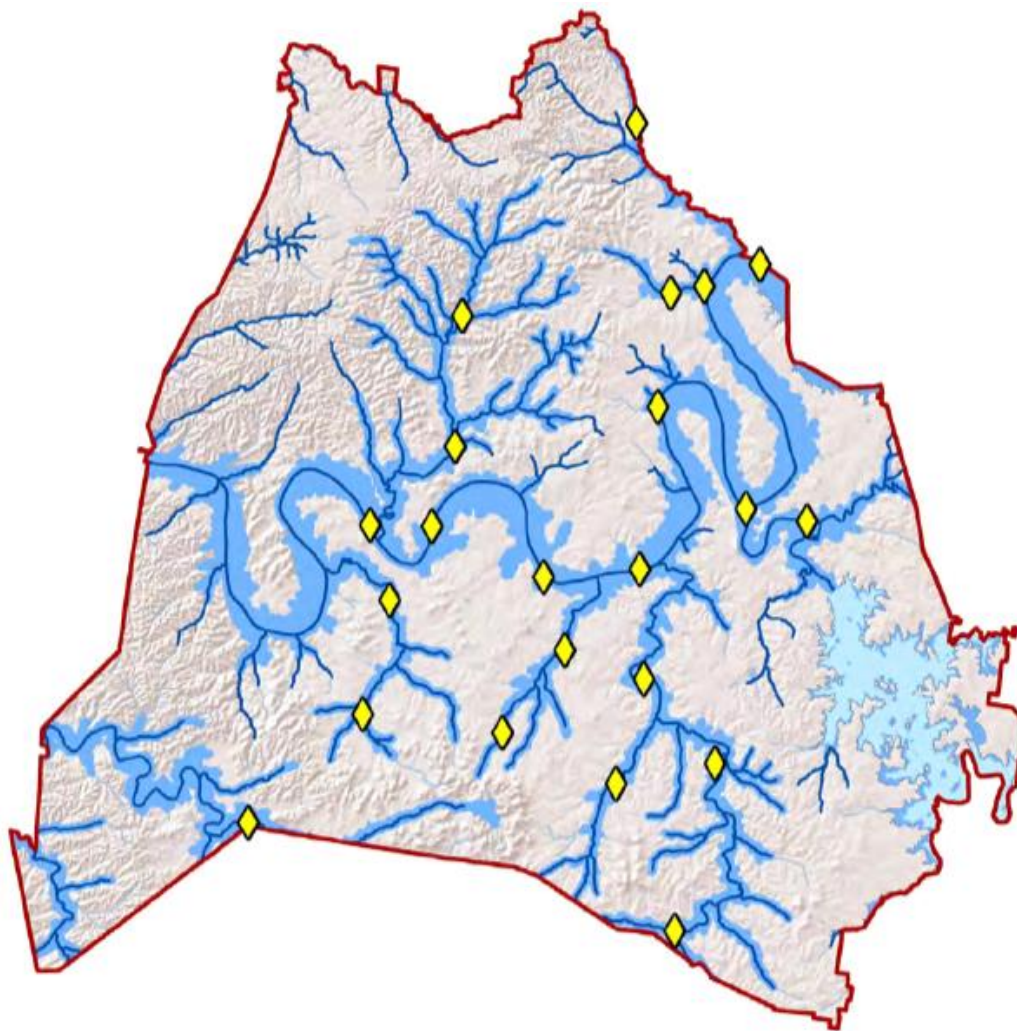
Nashville Emergency Response Viewing Engine (NERVE)

- ❖ Public Online Tool
- ❖ Real-time Info During Disasters
 - Road Closures
 - Evacuation Areas
 - School Closings
 - Locations of Shelters, Food and Water Distribution Centers, and Disaster Assistance Centers
- ❖ Navigate Residents to the Closest Shelters and Other Resources

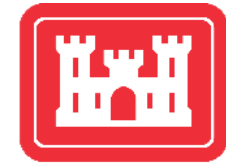


Data / Modeling / Mapping

22 New Gage Stations

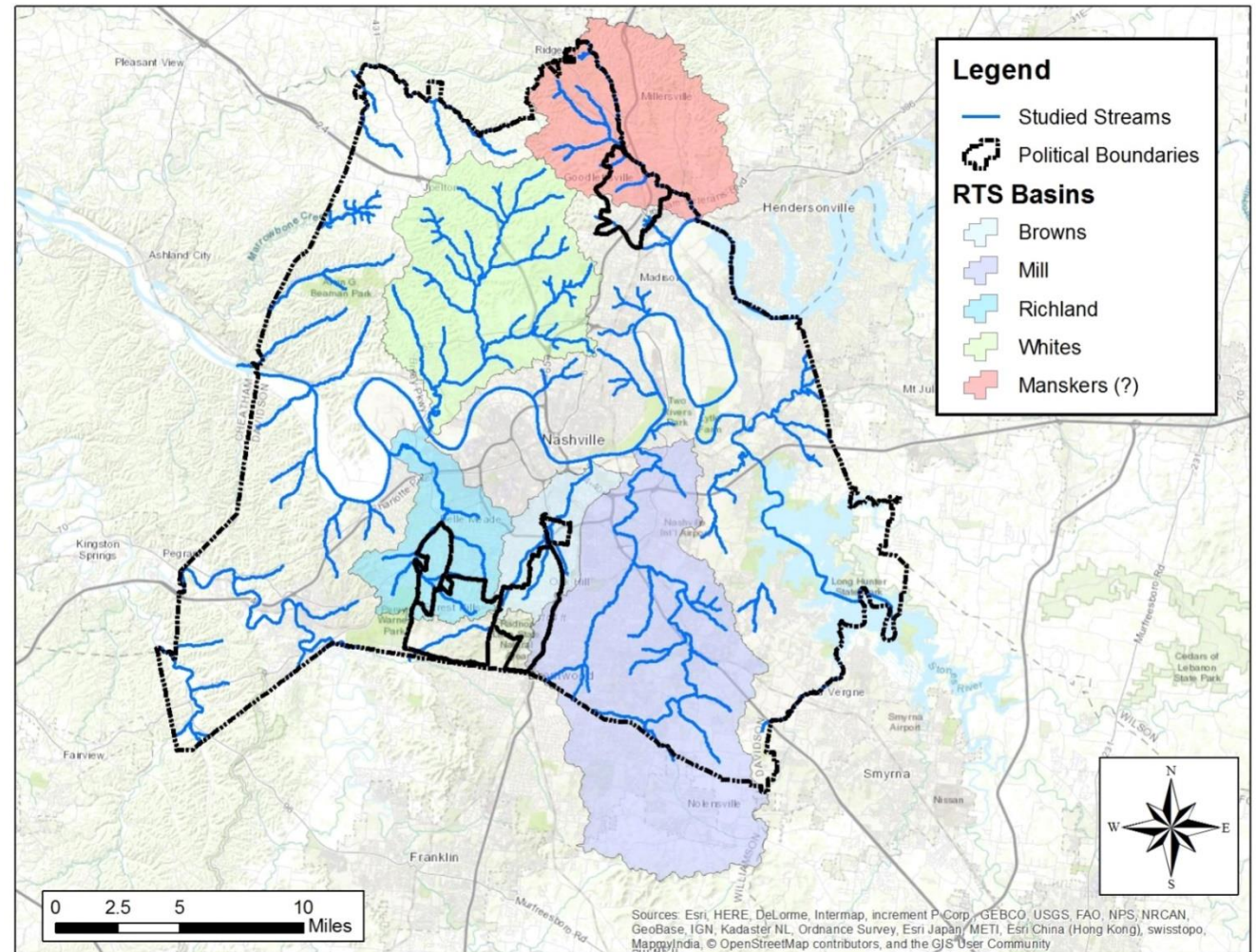
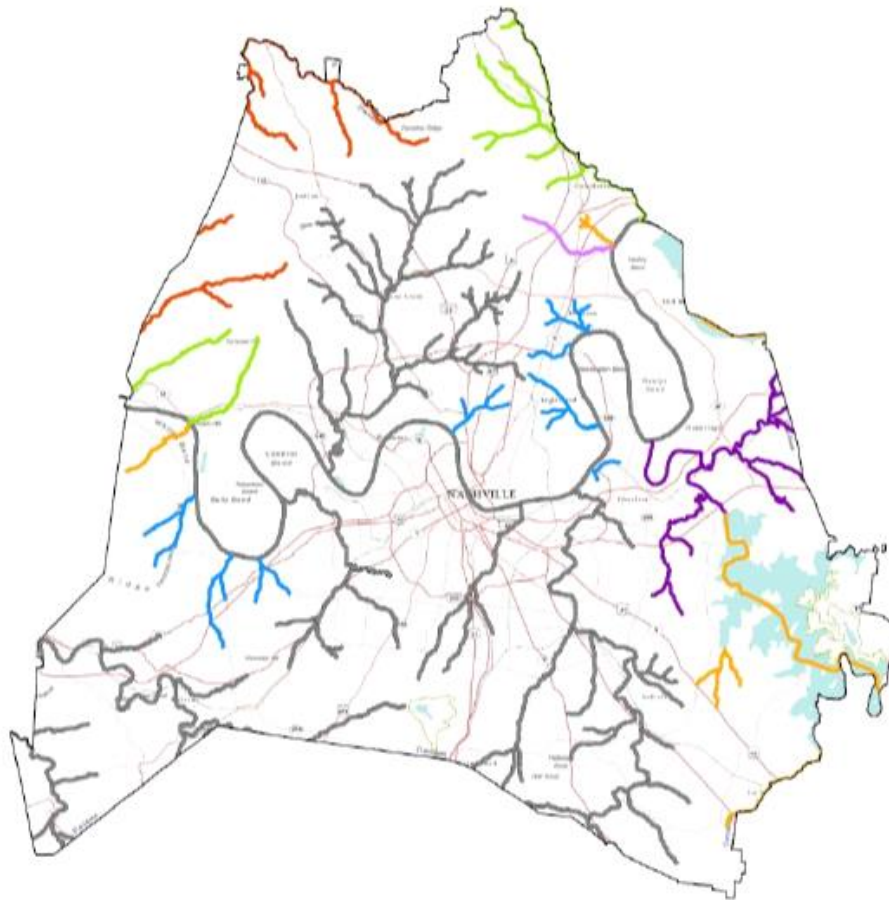


Data / Modeling / Mapping



US Army Corps
of Engineers

100's of Miles of FIS Updates

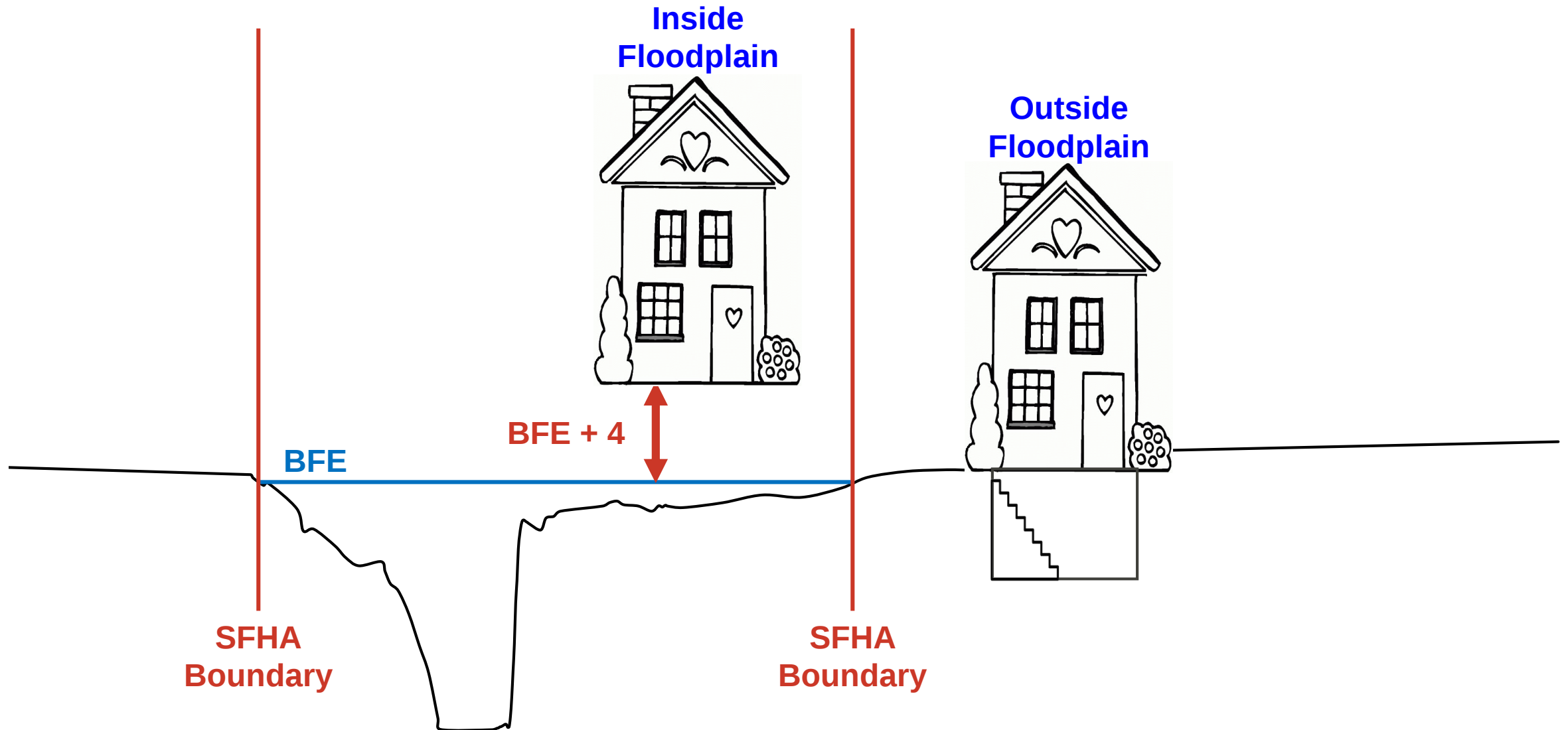


Regulation Assessment

- ❖ Some Recommendations were
 - Better Models / Mapping / Studies
 - Treat Commercial (BFE+1) like Residential (BFE+4)
 - Apply “BFE +” Criteria Beyond the Mapped Floodplain
 - Use Full-Buildout Watershed Conditions for “BFE +” Criteria
 - Better Downstream Assessment of Development Impacts
 - Adopt No Adverse Impact (NAI) Policies



BFE Criteria Beyond Mapped Floodplain?





Lord, Grant Me the Serenity to Accept the Things
I Cannot Change...



Nashville Flood of Record A 10-year Retrospective

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