



# New Jersey Mitigation Assessment Team (MAT) Outbrief Superstorm Sandy



An Overview of the MAT in NJ and Next Steps

December 20, 2012



# Presentation Outline

1. Mitigation Assessment Team (MAT) Program Background
2. Summary of MAT Field Work
3. Potential Recovery Advisory Topics and other MAT Support
4. MAT Report
5. Available Resources
6. Question and Answer



# 1. MAT Program Background

## Mitigation Assessment Team (MAT)

- Investigates building performance under severe hazard events
- Determines causes of building damage, failure and success
- Evaluates performance of mitigation projects
- Provides design and construction recommendations for reducing damage and protecting lives in hazard areas
- Draws on combined resources of Federal, State, local, and private sectors
- Supports building science/building code elements of NDRF



# 1. MAT Program Background



## MAT Reports

- Include recovery advisories observations, conclusions, and recommendations
- Past reports include:
  - Hurricane Isaac (TBD)
  - Spring 2011 Tornadoes (FEMA P-908)
  - Hurricane Ike (FEMA P-757)
  - Midwest Floods of 2008 (FEMA P-765)
  - Hurricane Katrina (FEMA 549)
  - Hurricane Charley (FEMA 488)
  - Hurricane Ivan (FEMA 489)



# 1. MAT Program Background

## Implementing MAT Results

- FEMA Publications
  - P-320/P-361 (Residential and Community Safe Rooms)
  - P-543/P-577/P-424 (Critical Facilities/Hospitals/Schools)
  - P-55/P-499/P-550 (Coastal Construction)
- Codes and Standards
  - ICC/NSSA Storm Shelter Standard (ICC-500)
  - Florida Building Code Upgrades (Glazing, Asphalt Shingles, Tile Roofing, Panhandle exemption removed, comprehensive flood provisions)
  - ASCE 7 Minimum Design Loads for Buildings and Other Structures
  - ASCE 24-05 Flood Design Standard, adopted by ICC
  - State building code adoption efforts (Louisiana/Mississippi post-Katrina)
  - 2015 International Building Code: Safe Rooms required by code
- Inform/Influence HMA requirements and RiskMAP products





# 1. Hurricane Sandy MAT Schedule



**INITIAL RECON TEAM TO JERSEY SHORE**  
November 6

**HURRICANE SANDY LANDFALL**  
October 29



**AERIAL RECONNAISSANCE NEW JERSEY AND NEW YORK**  
November 26



**RECOVERY ADVISORIES COMPLETE**  
February

**BRIEFINGS AND OUTREACH**

**MAT REPORT COMPLETE**  
September



**PRE-MAT DEPLOYMENT NEW JERSEY AND NEW YORK**  
November 15-18

**FIELD INVESTIGATIONS NEW JERSEY AND NEW YORK**  
December 5-20

**SME AND TECHNICAL ASSISTANCE TO JFO**

**CODE PROPOSALS**





# 1. NJ MAT Teams and Partners

## Teams

- Coastal
- Hospitals and Other Critical Facilities
- High-Rise, Police, Fire, and Schools
- Historic

## Team Members

- FEMA
- NIST
- ICC
- NAHB
- HUD
- Industry
- Higher education
- National subject matter experts

## Partners

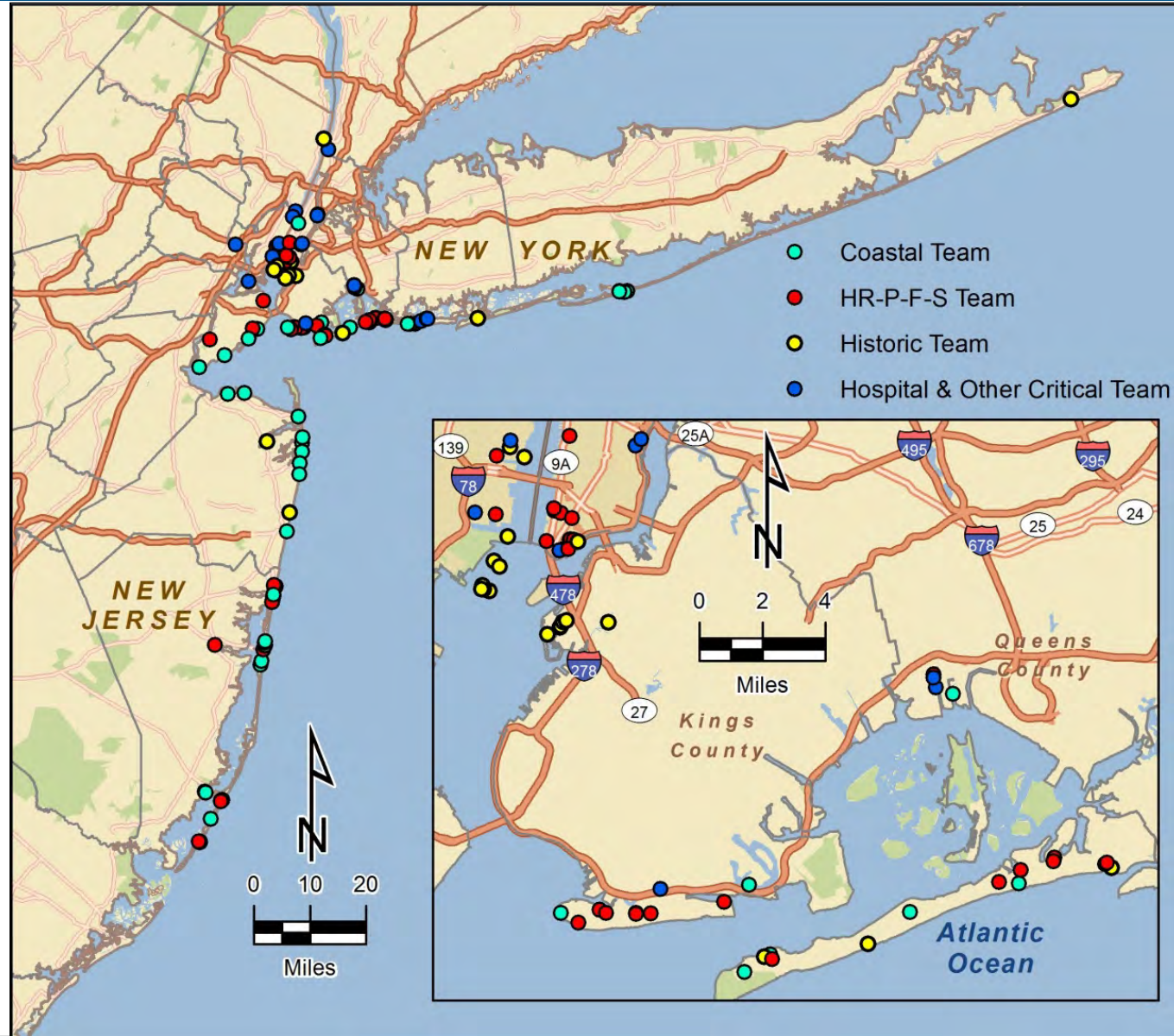
- Local
- Sea Grant
- HHS
- DOE
- EPA
- NJ Builders Association



## 2. Summary of MAT Field Work

### MAT deployed in 4 sub-teams:

- Coastal Team
- Hospitals and Other Critical Facilities Team
- High-Rise, Police, Fire, and Schools Team
- Historic Team







# 3. Data, GIS, ABFE, and Mapping

- The MAT is working across FEMA groups and Federal Agencies to coordinate data
- FEMA Modeling Task Force (MOTF) produced high resolution Hurricane Sandy depth grids and flood extents using USGS HWM Points – used by teams in the field



## 2. Coastal

### Key Locations Visited

#### OCEAN COUNTY:

- Manahawkin
- Beach Haven
- Seaside Park
- Seaside Heights
- Ortley Beach
- Lavallette
- Normandy Beach
- Mantoloking

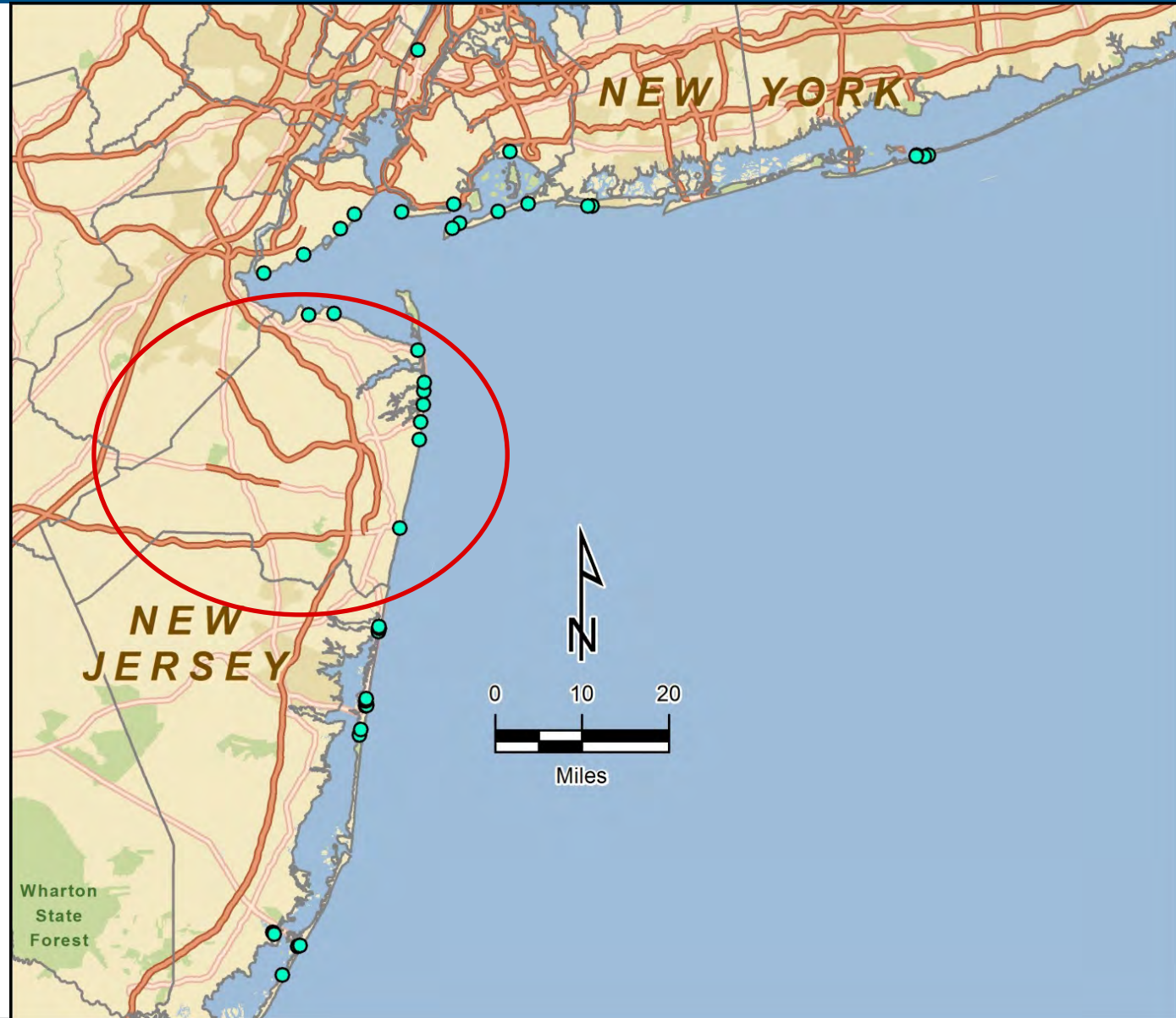


## 2. Coastal

### Key Locations Visited

#### MONMOUTH COUNTY:

- Manasquan
- Sea Girt
- Belmar
- Asbury Park
- Long Branch
- Monmouth Beach
- Sea Bright
- Highlands
- Keansburg
- Union Beach





# 2. Coastal







## 2. Coastal

### Key observations

- Widespread damage from inundation and shallow flooding
- Mechanical and utility equipment in lower levels and basements were flooded





## 2. Coastal

### Key observations

- Erosion and wave damage along shoreline







## 2. Coastal

### Key observations

- Wide dunes and beaches reduced damage





## 2. Coastal

### Key observations

- Building damage in close proximity to shore protection







## 2. Coastal

### Key observations

- Local scour and undermining of shallow foundations







## 2. Coastal

### Key observations

- Load Path issues with old and new construction







## 2. Coastal

### Key observations

- Inadequate foundations for coastal flood and erosion conditions







## 2. Coastal

### Key observations

- New construction was placed atop old foundations







## 2. Coastal

### Key observations

- Floodborne debris (buildings, boardwalks) was plentiful





## 2. Coastal

### **Analysis Focus Areas:**

- Coastal Foundations
- Continuous Load Paths
- Elevation of Equipment and Utilities
- Proximity to Shore Protection and Debris Sources





## 2. Coastal

### Take-Aways/ Successful Stories

- Owner elected to elevate above BFE before Sandy





## 2. Coastal

### Take-Aways/ Successful Stories

- Builder elected to elevate above BFE before Sandy







## 2. Coastal

### Take-Aways/Successful Stories

- Longer straps between foundation and floor joists helped building in background stay on foundation (similar house in foreground had short straps)



# 2. Hospitals, Other Critical Facilities



## Key Locations Visited

- Palisades Medical Center
- Hoboken University Medical Center
- Bayonne Medical Center
- Jersey City Medical Center
- Nursing Home/Senior Care Centers
- PATH Harrison Maintenance Facility
- PATH Hoboken Terminal
- Passaic Valley WWTP
- Gas stations







## 2. Hospitals

### **Key Observations: Hospitals**

- Loss of Emergency Power
- Loss of Vertical Conveyance/Elevators
- Loss of Domestic/Potable Water
- Loss of Telecom/IT
- Loss of Equipment
- Submarine Door Enclosure Performance
- Loss of Hospital Services



# 2. Hospitals

## Key Observations: Hospitals

- Loss of Emergency Power
  - Loss of fuel to generator (tank failure or inability to pump)
  - Inundation of emergency power equipment (generator set) or emergency power distribution equipment (switchgear)
- Loss of Vertical Conveyance/Elevators
  - Controls lost (sensors in elevator pit)
  - Loss of power







## 2. Hospitals

### Key Observations: Hospitals (continued)

- Loss of Domestic/Potable Water
  - Internal failure - Loss of booster pumps or pumps that fill the tanks
  - External failure - Loss of municipal water
- Loss of Telecom/IT
- Loss of Equipment
  - Emergency room equipment
  - Radiology equipment
  - Other equipment



# 2. Hospitals

## Key Observations: Hospitals (continued)

### Hospital Baseline Information

	Palisades	Hoboken	Jersey City	Bayonne
<b>In-Patient</b>				
Total Beds	202	160	293	N. I.
Avg Daily Census	150	140	N. I.	N. I.
Annual Discharges	10,780	N. I.	N. I.	N. I.
ICU Beds	10	N. I.	N. I.	15
Peds Beds	6	26	N. I.	0
Psychiatric Beds	0	52	30	15
<b>Out-Patient</b>				
Annual ED Visits	29,972	40,000	67,000	26,000
Annual Clinic Visits	NA	N. I.	Psych only	NA

## Impact on Clinical Services

W= Direct loss due to water, P= Indirect loss due to power, N= No loss, NA= Service not provided

	Palisades	Hoboken	Jersey City	Bayonne
<b>In-Patient</b>				
Med-Surg Beds	P	P	P	P
ICU Beds	P	P	P	P
Pediatric Beds	NA	P	P	P
Psychiatric Beds	NA	P	P	P
<b>Clinical Services</b>				
Major ORs	P	P	P	P
Minor ORs	W/P	P	P	P
Radiology	W/P	W/P	P	P
Laboratory	W/P	P	P	P
Dialysis	P	NA	P	P
<b>Out-Patient</b>				
Emergency Department	P	W	W/P	P
Clinics	NA	W	W/P	P
<b>Support Services</b>				
Kitchen	P	W	P	P
Laundry	P	NA	P	P
Admin	P	W	P	P
Med Record	P	W/P	P	P





## 2. Other Critical Facilities

### Key Observations: Other Critical Facilities

- Senior Care Centers
  - Same issues as hospitals
- PATH Facilities
- Passaic Valley Wastewater Treatment Plant
- Gas Stations





## 2. Hospitals, Other Critical Facilities

### Analysis Focus Areas

- Flood damage nearly all due to inundation (i.e, hydrostatic, not hydrodynamic forces)
- Emergency power system design focus is to mitigate normal power loss, not flood or high wind event
- Flood protection planning typically in two dimensions instead of three (i.e., perimeter wall openings protected but not floor drains)
- Fuel tank location relative to emergency generator



## 2. Hospitals, Other Critical Facilities

### Key Take-Aways/Success Stories

- *Below-grade spaces and utility systems are extremely vulnerable to inundation*
- Emergency power systems are not being looked at holistically
  - Emergency power systems are more vulnerable to flooding than normal power
- Examine quick connects for temporary power and other systems
- Consider Building code changes related to electrical systems (NFPA 99)





## 2. Hospitals, Other Critical Facilities

### Key Take-Aways/Success Stories

- Examine Critical Facility Functionality
  - Elevate or floodproof critical utility systems
  - Elevate or floodproof critical equipment
  - Relocate non-critical services to lower levels (i.e., below-grade or at grade)
- Protect fuel supplies for emergency power systems (focus on liquid fuels – diesel and fuel oil)
  - Day tanks
  - Pumping systems
  - Main fuel tanks
  - Tank vents



## 2. Hospitals, Other Critical Facilities

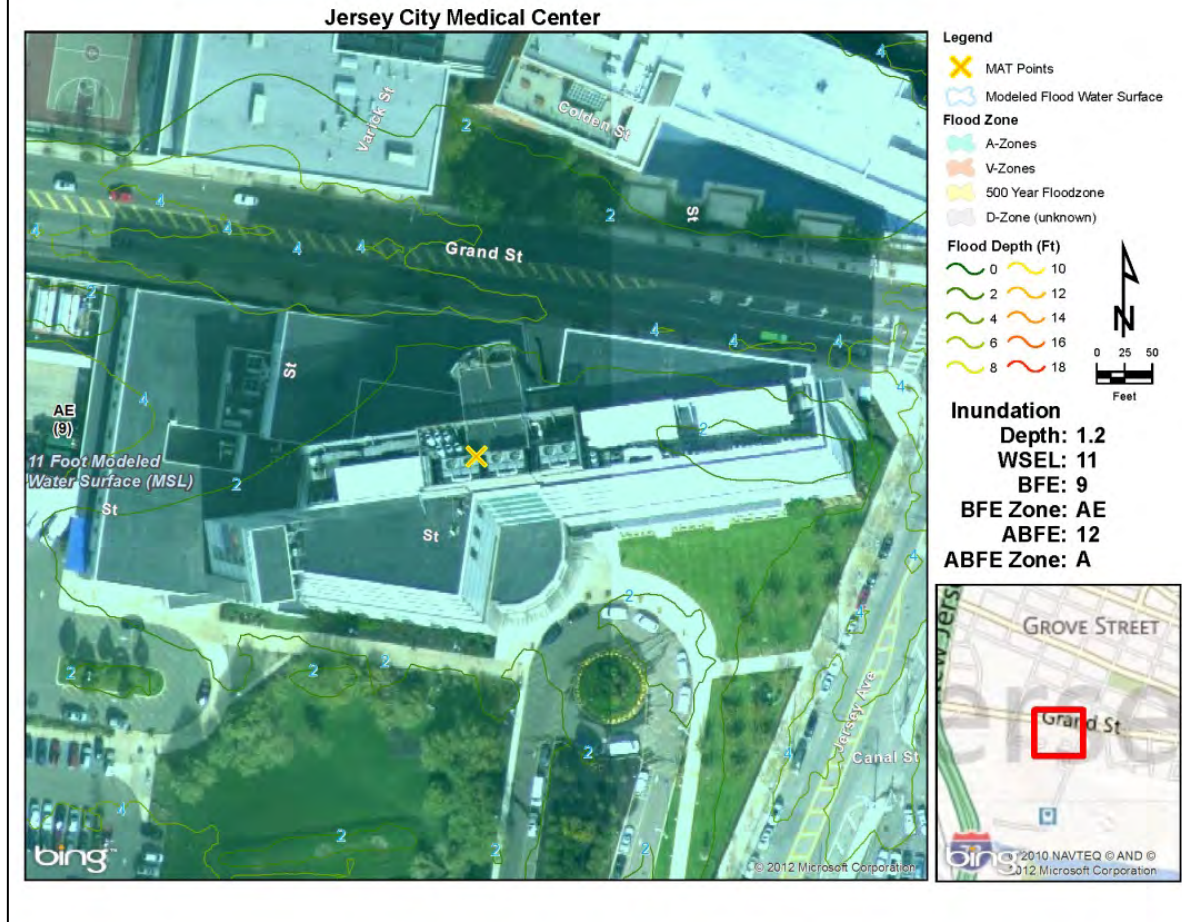
### Key Take-Aways/Success Stories

- Mitigate electrical systems
  - Emergency Power
    - Elevate generator
    - Elevate distribution equipment
    - Isolate supplies to vulnerable equipment (i.e., pumps, lighting below BFE)
  - Normal Power
    - Elevate main switchgear
    - Elevate utility transformers (i.e., pad-mounted vs. vault)
    - Elevate distribution equipment
    - Isolate supplies to vulnerable equipment (i.e., pumps, lighting below BFE)
- Install new connections or maintain existing connections for temporary utilities (i.e., power, potable water, heat)

# 2. Hospitals, Other Critical Facilities

## Success Story: Jersey City Medical Center (Jersey City, NJ)

- Post-FIRM facility constructed in 2004
- Back-up power generators functioned properly and expect to be fully operational in January 2013



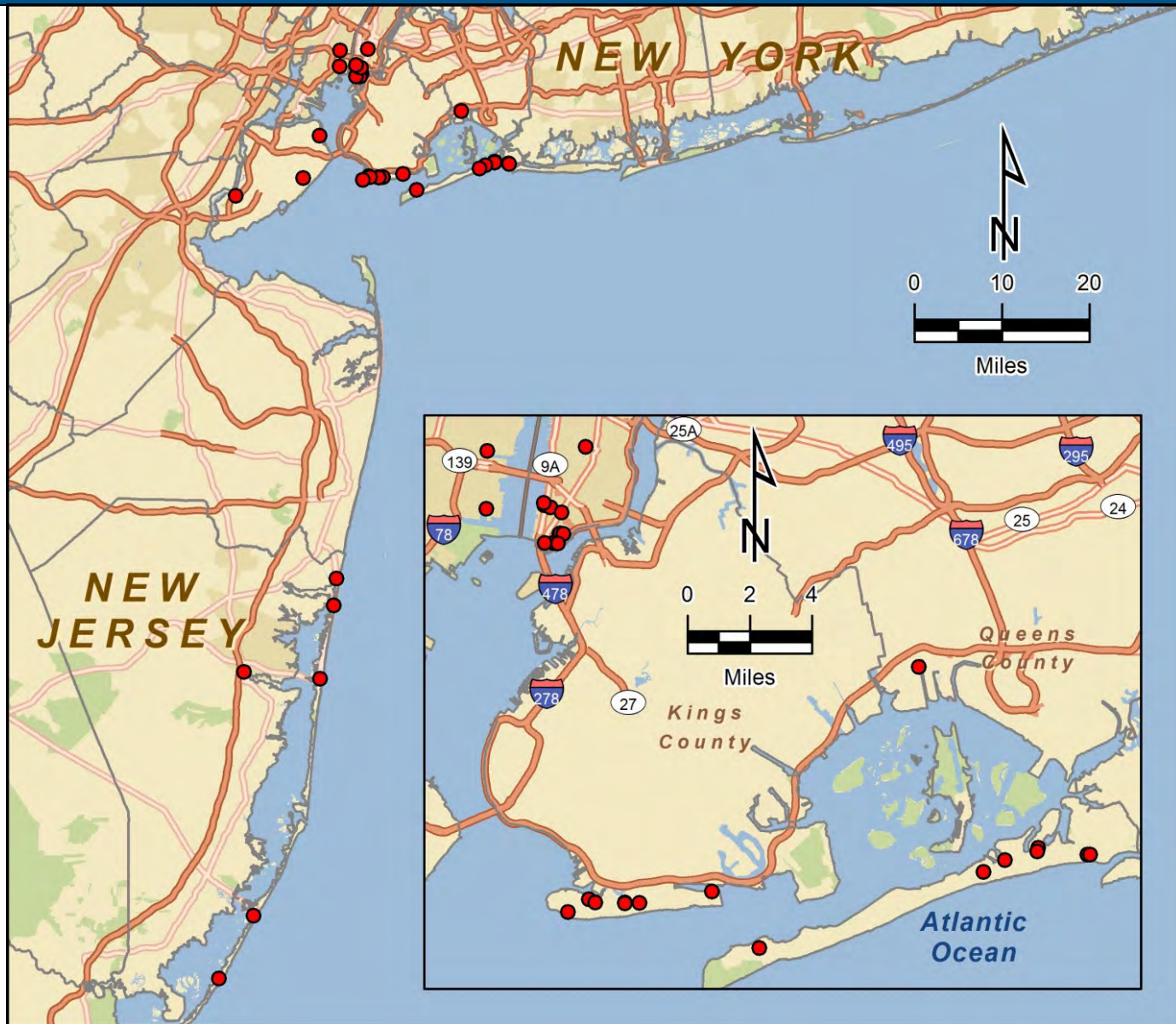




## 2. High Rise, Police, Fire, Schools

### Key Locations Visited

- Approximately
  - 2 Schools
  - 18 Fire/EMS
  - 7 Police
  - 1 High Rise





## 2. High Rise

### Summary of Locations Visited: High-Rise

- Jersey City
- Age of construction
  - 2006
- Occupancy Type
  - Residential







## 2. High Rise

### Key Observations: High-Rise

- Damages
  - Damage within parking garage with ongoing repairs
  - Vehicles with parking garage and trash compactor in lower level
- Utilities were elevated
  - Emergency switch gear and generator elevated along first floor
  - Mechanical room on top floor







## 2. High Rise

### Analysis Focus Areas: High-Rise

- Floodproofing
- Mechanical/Electrical Rooms
- Sustainability





## 2. High Rise

### Key Take-Away/ Success Stories: High-Rise

- Elevate mechanical and electrical service components
- Require emergency power for floodproofed buildings







## 2. Police and Fire

### Summary of Locations Visited: Police and Fire

- Varied in age of construction
- Facilities with and without basements







## 2. Police and Fire

### Key Observations: Police and Fire

- Minimal structural and envelope damage
- Utilities in basements or not elevated on first floor, damaged
- Emergency Power
- Damage varied based on elevation of equipment
- Damage to first floor contents/equipment





## 2. Police and Fire

### Analysis Focus Areas: Police and Fire

- Impact on emergency services
- Mechanical/Electrical Rooms
- Floodproofing opportunities











## 2. Police and Fire

### Key Take-Away/Success Stories: Police and Fire

- Elevate mechanical and electrical service components
  - FEMA Recovery Policy 9526.1 allows for Hazard Mitigation Funding Under Section 406 (Stafford Act) to elevate electrical panels, machinery rooms, and emergency generators above the BFE or dry floodproof them in buildings not substantially damaged as long as the mitigation costs are within 100% of the repairs cost (otherwise a traditional benefit-cost analysis is required). Maximize on this mitigation opportunity.
- Design above 0.2% annual chance flood (500-year)
- Install/require emergency power in fire and police stations



# 2. Schools

## Summary of Locations Visited: Schools

- Sites were Pre FIRM
- Ocean County





## 2. Schools

### Key Observations: Schools

- Inundated with about 2' of water in one school and basement of other school
- Elevation/location of utilities was the critical factor





## 2. Schools

### Analysis Focus Areas: Schools

- Building and contents damage
- Mechanical/Electrical Rooms
- Floodproofing opportunities





## 2. Schools

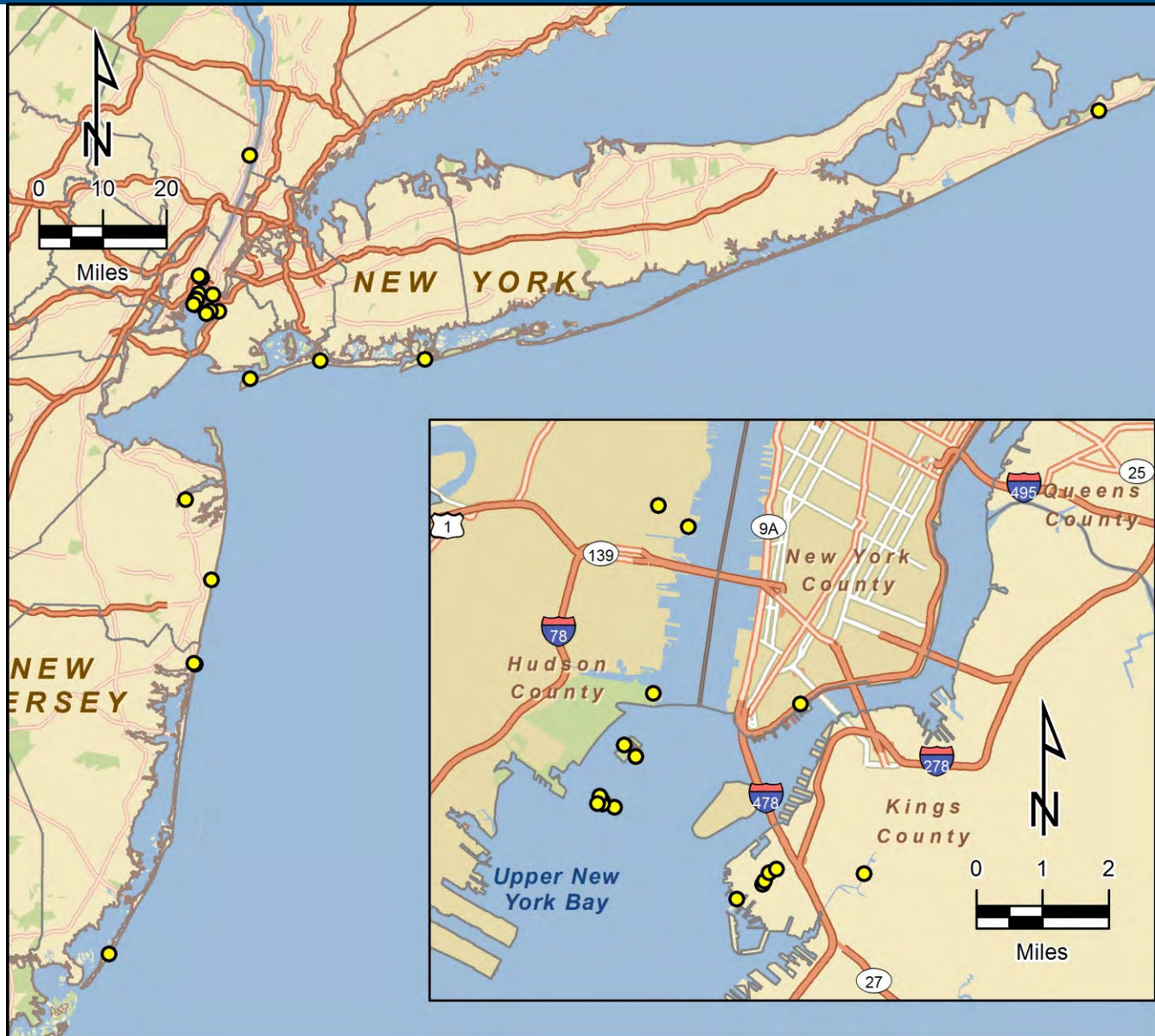
### Key Take-Away/Success Stories: Schools

- Elevate mechanical and electrical service components
  - FEMA Recovery Policy 9526.1 allows for Hazard Mitigation Funding Under Section 406 (Stafford Act) to elevate electrical panels, machinery rooms, and emergency generators above the BFE or dry floodproof. Maximize on this mitigation opportunity.
- Design above 0.2% annual chance flood (500-year)
- Require emergency power in any floodproofed buildings

# 2. Historic

## Key Locations Visited

- Ellis Island
- Red Hook, Brooklyn
- Lower Manhattan
- Queens







## 2. Historic

### Apartment Building

- 123 Willow Street, Hoboken, NJ 07030
- Below grade basement inundated with floodwaters
- High water mark indicated in red (left slide)





## 2. Historic

### All Saints Episcopal Church

- 500 Lake Avenue, Bay Head, NJ 08742
- Removal of exterior shingles to dry interior woodwork
- Bulkhead at bank replaced







## 2. Historic

### Summary of Locations Visited: Historic

#### Erie Lackawanna Railway – Hoboken Terminal

- Minimal structural damage
- Utilities, equipment and train cars damaged from floodwaters.
- HWM approximately 5' above ground







## 2. Historic

### Key Observations

- **Elevation:** Many historic buildings are not suitable for elevation due to their historic appearance and siting constraints
- **Opening Protection:** Abundant replacement window and door damage
- **Boardwalks:** Failures had weak connections, inadequate plank nailing, and flow-through obstructions
- **Structural:** Unreinforced masonry hydrostatic pressure failures were common



## 2. Historic

### Analysis Focus Areas

- **Elevation needs:** Utilities and buildings (where feasible)
- **Opening Protection:** Flood-resistant window and door replacements - retain building character and protects aesthetics
- **Boardwalks:** Community interest to retain setting, location, and historic appearance, with more resilient reconstruction
- **Structural:** Retrofit methods for hardening unreinforced buildings that protects aesthetics
- **Secondary Mitigations:** Contingency preparations to protect historic features in the event that primary mitigations are inadequate



## 2. Historic

### Take-Aways/Success Stories

- Increase MAT outreach to Historic Preservation groups and organizations
- More analysis on the initial response of property owners to protect their structures
- Strong support for sustainable protection of historic properties
- Open design of some structures allows flow through and reduces damage



# 3. MAT Support





# 3. Recovery Advisories

## Updated Guidance

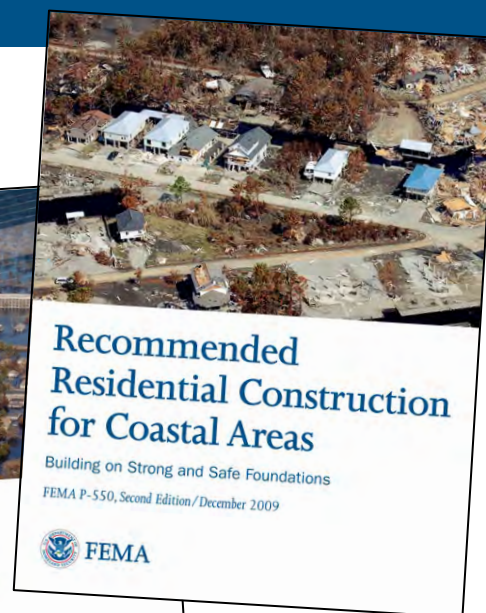
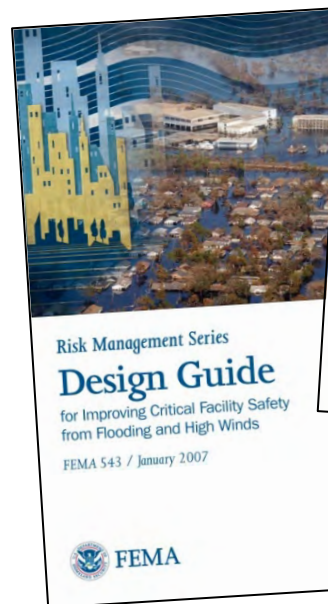
- Potential topics include:
  - Initial Restoration of Flooded Buildings
  - Designing for Flood Levels Above the BFE
  - Load Paths for Coastal Buildings
  - Erosion, Scour, and Foundation Design
  - Considerations for Improving Your Critical Facility Functionality

## NEW:

- Potential topics include:
  - Restoration of Utilities in Non-Substantially Damaged 1-4 Family Residential Buildings
  - Mid- and High-Rise Building Flood Mitigation
  - Providing Fuel for Emergency Power Systems
  - Design of Facilities in Close Proximity to Shore Protection and Dunes
  - Historic Buildings
  - Designing for Flood Levels Above ABFE/BFE
  - Construction in Coastal A Zones
  - Other

# 3. MAT Support

- Technical Assistance to JFO
- Building code technical assistance
- Briefings and outreach
- Potential training courses
  - Residential Coastal Construction
  - Improving Critical Facility Safety From Flooding and High Winds
  - Flood Provisions of the I-Code Series, ASCE 24 and Flood CodeMaster
  - Best Practices for Flood and Wind Mitigation
  - Coastal Foundation Design and Construction for Design Professionals
  - Retrofitting Floodprone Buildings
  - NFIP Technical Bulletins







# 3. MAT Support – Code Changes

## 2015 IRC Code Change Proposal: FEMA Proponent

- Section R322.2.3: Flood-resistant masonry foundation walls
- Enhanced Reinforcement Tables proposed
- Coastal A Zone (CAZ) and Zone A (non-CAZ)
- Tables per Flood Load Analysis
- Sandy MAT Observations cited
- Proposal can help rebuild stronger
- Code cycle begins in January



# 4. MAT Report

Comprehensive MAT Report summarizing the observations, conclusions, and recommendations made by a collaborating team of subject matter experts, industry, higher education professionals, and Federal, State, and local government officials





# 5. Available Building Science Resources

- Hurricane Sandy page created on FEMA.gov <http://www.fema.gov/building-science/hurricane-sandy-building-science-activities-resources>
- Contains
  - Relevant flyers
  - Publications
  - Brochures
  - Resources and links
  - Toolkit CD and Building Science Catalog

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Plan, Prepare & Mitigate > Safer, Stronger, Protected Homes & Communities > What is Building Science? > Hurricane Sandy – Building Science Activities & Resources

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**Hurricane Sandy – Building Science Activities & Resources** Share/Email This Page

The FEMA Building Science Branch will be adding additional flyers, recovery advisories, technical bulletins, and fact sheets. Please check back often to view the new material.

**Hurricane Sandy Flyers**

- [FEMA Building Science Resources to Assist with Reconstruction After Hurricane Sandy](#)
- [FEMA Building Science Training and Workshops for Hurricane Sandy](#)
- [Hurricane Sandy Issue Paper - Guidance for Turning the Power Back On](#)

**Building Science Flyers**

- [ABCs of Returning to Flooded Buildings](#)
- [FEMA Snow Load Safety Guidance](#)
- [Announcing Version 2.0 of the Substantial Damage Estimator Tool](#)

- Developed to assist State and local officials in determining substantial damage in accordance with a local floodplain management ordinance meeting the requirements of the National Flood Insurance Program (NFIP)
- Can be used to assess flood, wind, wildfire, seismic, and other forms of damage
- Helps communities to provide timely substantial damage determinations so that reconstruction can begin following a disaster.
- [Download the SDE Tool](#)



# 5. Available Resources

- FEMA Region II has set up an ABFE site:  
<http://www.region2coastal.com/sandy/abfe>
- Links to Building Science pages and resources
- Building Science providing key support for knowing risks, roles, and taking action

**FEMA Region II**  
**Coastal Analysis and Mapping**

Home | HURRICANE SANDY | Coastal Mapping Basics | FAQs | Additional Resources | Contacts

### Hurricane Sandy Advisory Base Flood Elevations (ABFEs) in New Jersey and New York

**Know Your Risk.**

View the Advisory Flood Hazards for your Location Today!

**ABFE Information is Now Available for the Following New Jersey Counties: Atlantic, Bergen, Burlington, Cape May, Essex, Hudson, Middlesex, Monmouth, Ocean, and Union.**

- View online through [FEMA's Interactive ABFE Map](#). [View the video tutorial](#) or [read the quick start guide](#). Mobile device users: zoom directly to

**Know Your Role.**

Learn Why ABFEs are Important to You!

FEMA will assist communities in applying the ABFEs as they evaluate their risk during the long term recovery and re-building phase. The ABFEs will also be provided to other Federal and State agencies and local governments to assist in carrying out their recovery efforts. Find out below why ABFEs are important to you.

**Community Officials** - State and

**Take Action!**

Explore How You Can Take Action Now!

As communities begin to recover from the devastating effects of Hurricane Sandy, it is important to recognize lessons being learned and to employ mitigation actions that ensure structures are rebuilt stronger, safer, and less vulnerable to future flooding events.

**Rebuild Safer and Stronger**

If your home or business has been flooded, you can utilize many of

# 6. Question and Answer



Flood/Wind Building Science Helpline:  
**FEMA-BuildingScienceHelp@dhs.gov**

**(866) 927-2104**

**<http://www.FEMA.gov/Rebuild/BuildingScience>**