



Northeast States Emergency Consortium

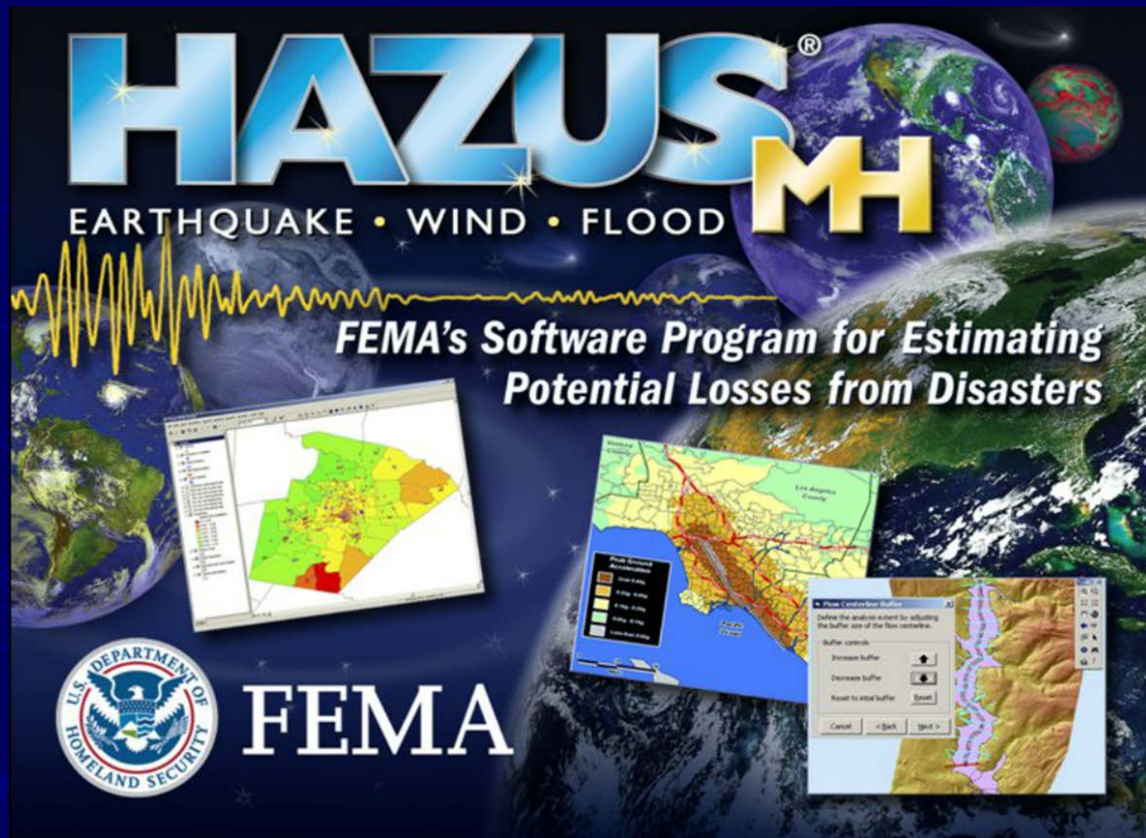
Using HAZUS to Estimate the Performance of Critical and Essential Facilities

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HAZUS Building Performance Outputs Use In Resiliency

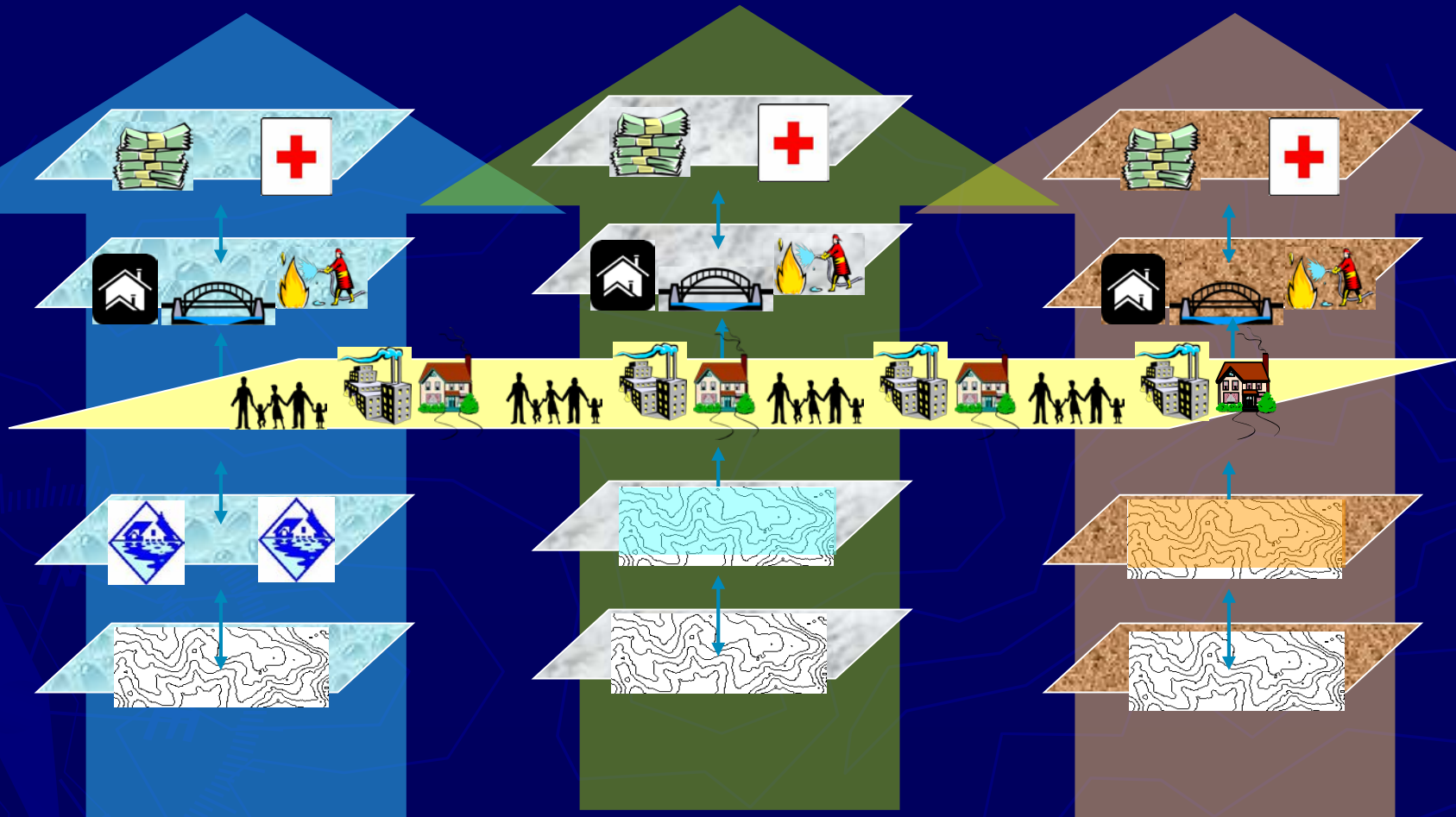
The purpose of this presentation is to review and discuss the applicability of HAZUS earthquake, flood and hurricane performance outputs for critical and essential facilities and their use in resiliency planning.

What is HAZUS-MH?



A GIS based tool developed by FEMA that estimates damage and losses resulting from selected natural hazards

HAZUS-MH Models



FLOOD

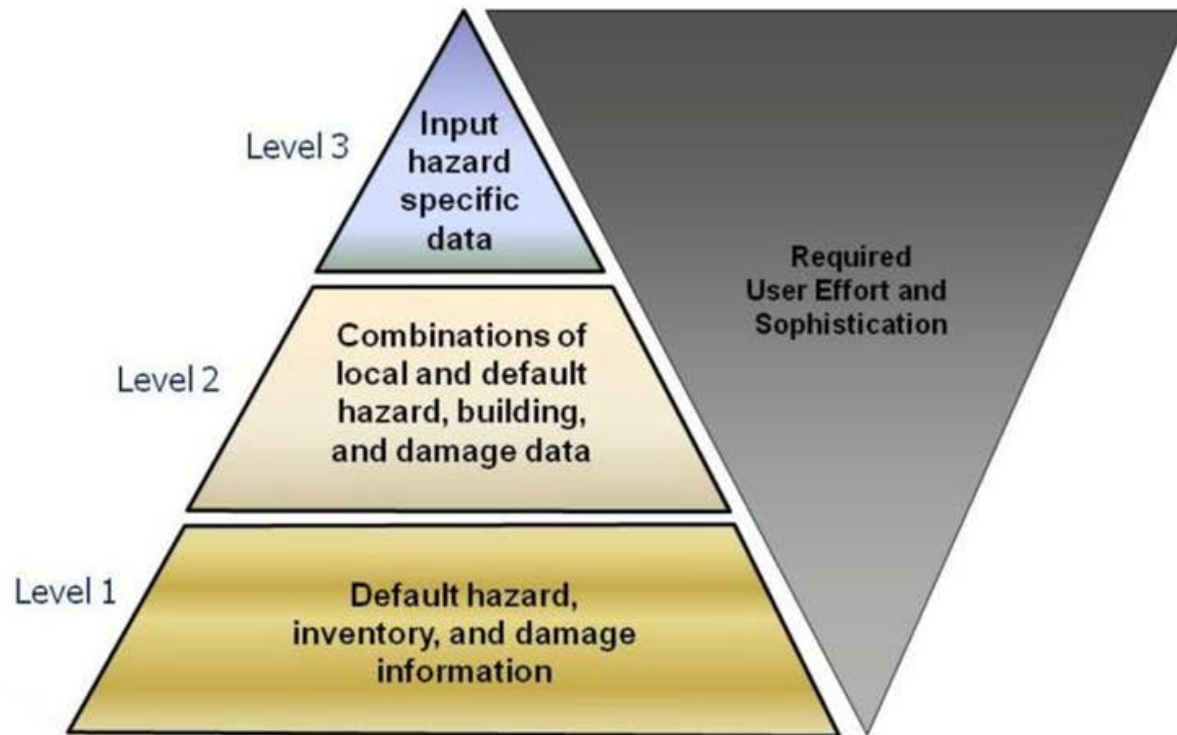
HURRICANE
WIND/SURGE

EARTHQUAKE

HAZUS Specific Building Performance Outputs Vary by Hazard

HAZUS 4.2 Capabilities	Earthquake Ground Shaking Ground Failure	Flood Frequency Depth Riverine Coastal Surge	Hurricane Wind Surge	Tsunami Depth Momentum Flux Runup Velocity
Inputs				
Historic	✓		✓	
Deterministic	✓	✓	✓	✓
Probabilistic	✓	✓	✓	
User-supplied	✓	✓	✓	✓
Other supported inputs	Real-time & scenario USGS ShakeMaps	Risk MAP, User-supplied depth grids (ArcGRID, GeoTIFF, IMAGINE), HEC-RAS (.FLT)	Hurrevac, User-supplied wind files (.dat)	NOAA PMEL SIFT, State models
Direct Damage				
General Building Stock	✓	✓	✓	✓
Essential Facilities	✓	✓	✓	
Transportation Systems	✓	✓		
Utility Systems	✓	✓		
User-Defined Facilities	✓	✓	✓	✓
Induced Damage				
Fire Following	✓			
Debris Generation	✓	✓	✓	
Direct Losses				
Cost of Repair	✓	✓	✓	✓
Income Loss	✓	✓	✓	✓
Agricultural		✓		
Casualties	✓			✓
Shelter and/or Evacuation Needs	✓	✓	✓	✓
Average Annualized Loss (AAL)	✓	✓	✓	

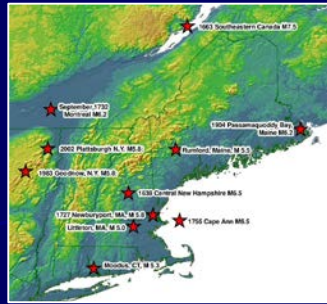
HAZUS Levels of Analysis



Critical and Essential Facilities

- **Emergency Response – Police, Fire ,
Emergency Operations Centers**
- **Medical Care Facilities – Hospitals and
Clinics**
- **Schools - Public, Private, Colleges &
Universities**
- **User Defined**

Nineteen Hazard Scenarios



**Central NH Earthquake 6.5
500, 1000 & 2500 Year Probabilistic
Earthquakes**



**1938 Hurricane
10, 20, 50, 100, 200, 500 & 1000 Year
Return Period Hurricanes**

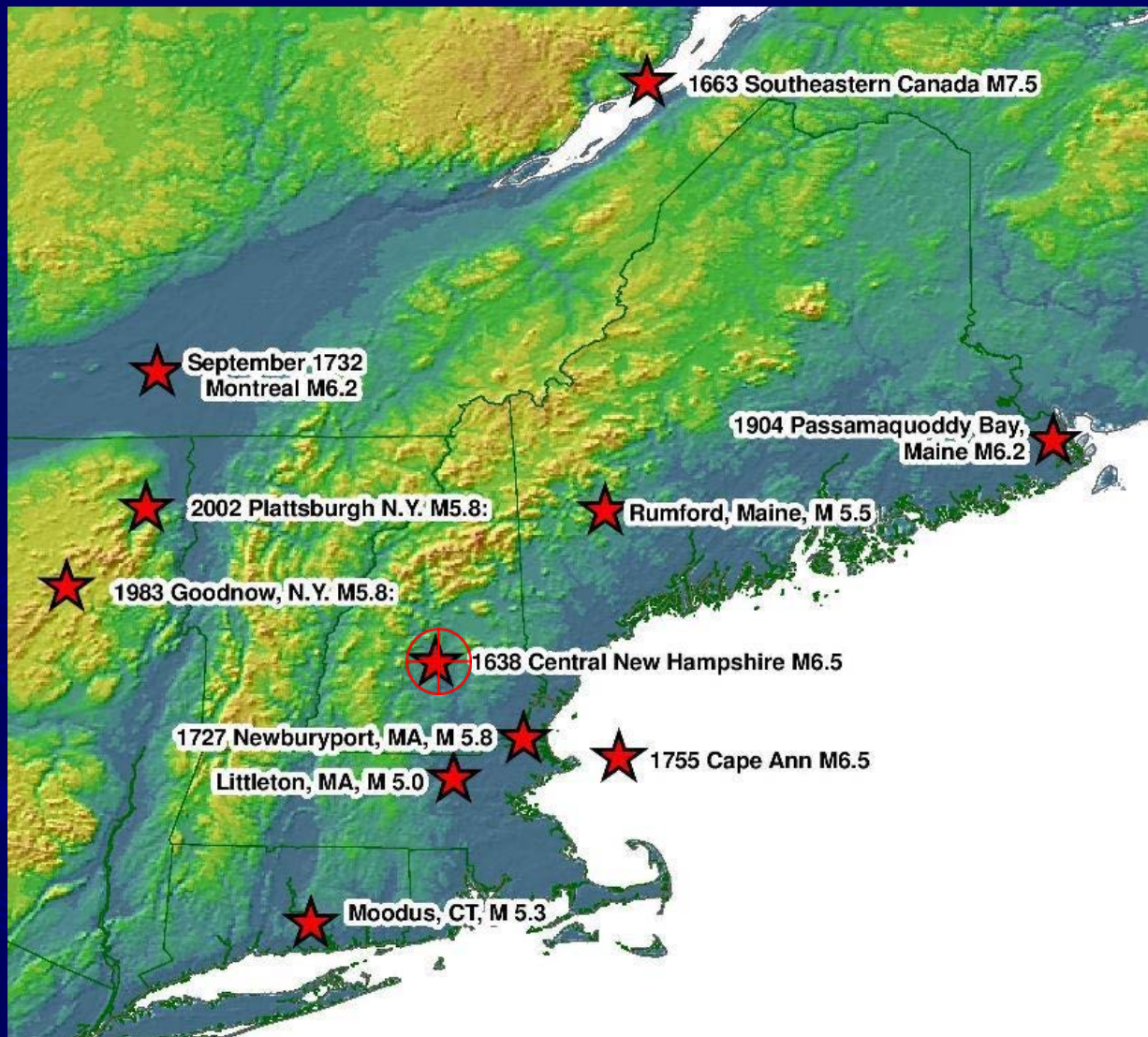


**10, 20, 50, 100, 200, 500 & 1000 Year
Flood Riverine**

EARTHQUAKE

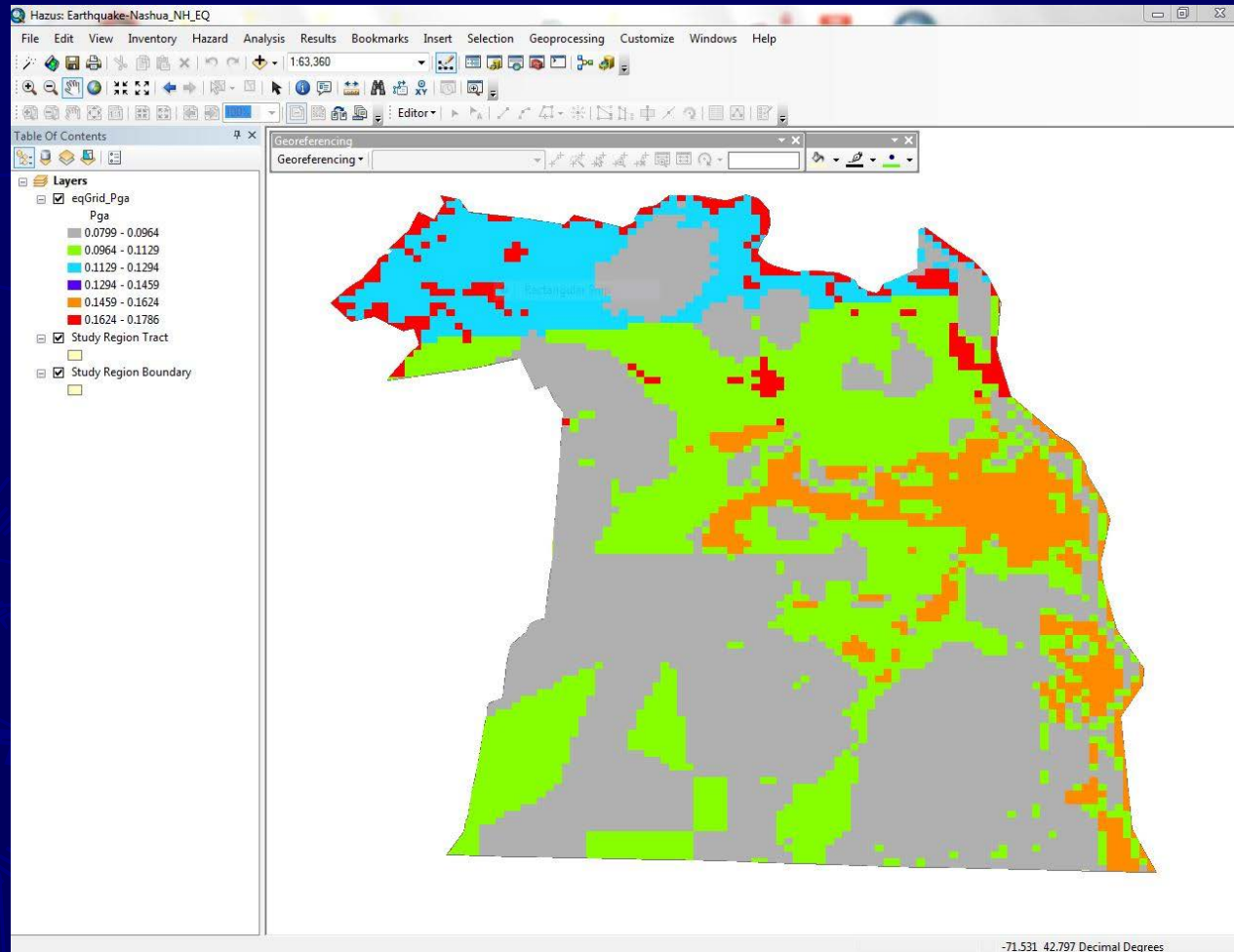


New England Earthquake Scenarios



Source: John Ebel (2015)

Ground shaking (PGA) for 6.5 Central NH Earthquake Event (With Soils)



HAZUS Earthquake Critical and Essential Facilities Performance Outputs

- **Probability of Functionality: Day 1, 3, 7, 14, 30 & 90**
- **Probability of Damage: None, Slight, Moderate, Extensive, Complete, At Least Slight, At Least Moderate & At Least Extensive**

Probability of Functionality of Essential Facilities - Schools

Essential Facilities Results

Medical Care Facilities | Emergency Response | **Schools**

Table type: School, Functionality

Table

	ID Number	Name	@ Day 1	@ Day 3	@ Day 7	@ Day 14	@ Day 30	@ Day 90
1	NH000788	Nashua HS North	78.90	79.10	90.90	91.20	99.40	99.60
2	NH000789	Birch Hill Elem School/Adult LC	72.00	72.40	87.20	87.50	98.40	99.00
3	NH000790	Broad Street Elem School/Adult LC	68.40	68.80	85.90	86.40	96.90	98.40
4	NH000791	Charlotte Ave Elem School/Adult LC	65.50	65.90	83.20	83.60	95.80	97.50
5	NH000792	Mt. Pleasant School	68.20	68.60	85.80	86.30	96.90	98.40
6	NH000793	Elm Street Middle School	68.60	69.00	86.10	86.50	97.00	98.40
7	NH000794	Ledge Street School/Adult LC	66.10	66.50	83.60	84.00	95.90	97.60
8	NH000795	Fairgrounds Middle School	51.20	51.70	72.90	73.40	91.60	94.90
9	NH000796	Fairgrounds Elem School/Adult LC	66.30	66.70	83.80	84.20	96.00	97.60
10	NH000797	Sunset Heights School/Adult LC	78.40	78.70	91.80	92.10	98.50	99.20
11	NH000798	New Searles School/Adult LC	78.50	78.80	91.80	92.20	98.50	99.20
12	NH000799	Nashua HS South/Purp Panthers Preschool	68.50	68.90	86.00	86.40	97.00	98.40
13	NH000800	Nashua Christian Academy	40.50	41.00	63.30	63.90	87.40	93.20
14	NH000801	St. Christopher School	67.90	68.30	85.60	86.10	96.90	98.40
15	NH000802	Nashua Catholic Regional Jr. High	76.90	77.30	91.00	91.40	98.30	99.10
16	NH000803	Infant Jesus School	12.60	12.80	24.00	24.30	61.50	75.20
17	NH000804	Nashua Title I Preschool	68.30	68.70	85.90	86.30	96.90	98.40
18	NH000805	Acad for Science and Design Chart School	76.90	77.20	91.50	91.80	98.70	99.30
19	NH000806	Bicentennial Elem School/Adult LC	92.10	92.20	97.60	97.70	99.80	99.90
20	NH000807	World Academy	92.10	92.30	97.60	97.80	99.90	99.90
21	NH000808	Main Dunstable School/Adult LC	56.90	57.40	76.40	76.90	95.70	97.40
22	NH000809	Bishop Guertin HS	73.00	73.40	89.70	90.10	98.40	99.10
23	NH000810	Amherst Street School/Adult LC	65.80	66.20	83.40	83.80	95.90	97.60
24	NH000811	Dr. Norman W. Crisp School/Adult LC	79.40	79.60	91.20	91.50	99.40	99.60
25	NH000812	Christian Bible Church Academy	75.70	76.20	95.00	95.50	99.80	99.90
26	NH000813	Nashua Childrens Home	76.60	77.00	95.30	95.80	99.80	99.90
27	NH000814	Pennichuck Middle School	75.20	75.70	94.90	95.30	99.80	99.90
28	NH000815	2nd Nature Academy	88.00	88.20	98.50	98.70	99.90	99.90

Probability of Damage Essential Facilities - Schools

Essential Facilities Results

Medical Care Facilities | Emergency Response | **Schools**

Table type: School, Structural Damage

Table

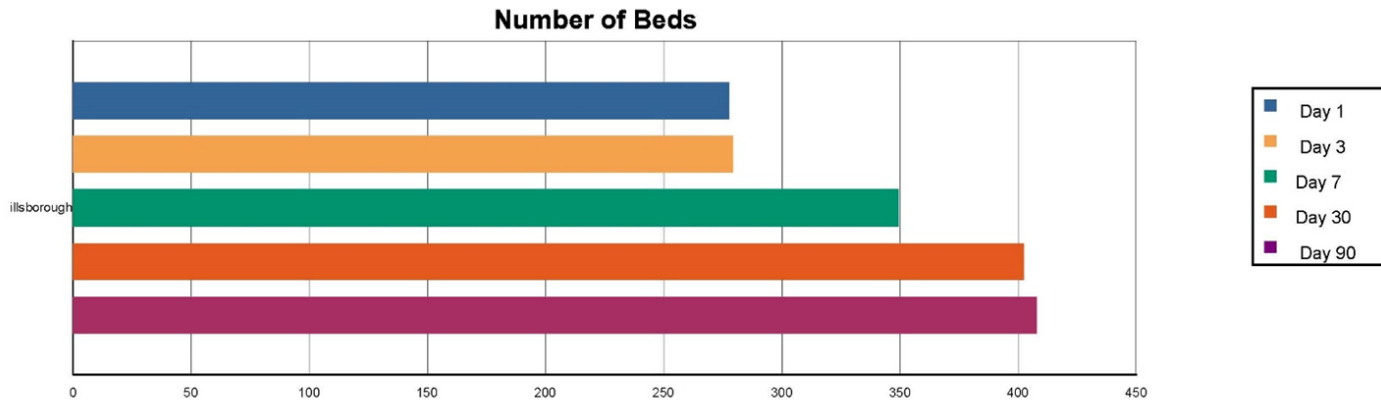
	ID Number	Name	None	Slight	Moderate	Extensive	Complete
1	NH000788	The Goddard School	0.763	0.134	0.095	0.006	0.001
2	NH000789	St. Joseph School of Nursing	0.779	0.124	0.088	0.008	0.001
3	NH000790	SNH Services - 11th Street Head Start	0.634	0.170	0.168	0.025	0.003
4	NH000791	Rivier University	0.783	0.123	0.086	0.008	0.001
5	NH000792	Rivier University	0.782	0.123	0.086	0.008	0.001
6	NH000793	Rivier University	0.782	0.123	0.086	0.008	0.001
7	NH000794	Rivier University	0.782	0.123	0.086	0.008	0.001
8	NH000795	Rivier University	0.782	0.123	0.086	0.008	0.001
9	NH000796	Rivier University	0.652	0.165	0.158	0.022	0.003
10	NH000797	Rivier University	0.782	0.123	0.086	0.008	0.001
11	NH000798	Rivier University	0.652	0.165	0.158	0.022	0.003
12	NH000799	Rivier University	0.652	0.165	0.158	0.022	0.003
13	NH000800	Rivier University	0.797	0.120	0.078	0.004	0.001
14	NH000801	Rivier University	0.884	0.077	0.037	0.001	0.000
15	NH000802	Nashua School District	0.788	0.123	0.082	0.005	0.001
16	NH000803	Nashua HS North	0.789	0.123	0.082	0.005	0.001
17	NH000804	Nashua Comm Coll/Hellenic University	0.581	0.180	0.199	0.034	0.005
18	NH000805	Little Pilgrim School	0.618	0.173	0.178	0.028	0.004
19	NH000806	Infant Jesus School	0.634	0.170	0.169	0.025	0.003
20	NH000807	Dr. Norman W. Crisp School/Adult LC	0.794	0.121	0.079	0.005	0.001
21	NH000808	Sunset Heights School/Adult LC	0.784	0.137	0.064	0.014	0.000
22	NH000809	St. Christopher School	0.680	0.181	0.108	0.030	0.001
23	NH000810	New Seales School/Adult LC	0.785	0.137	0.064	0.014	0.000
24	NH000811	Nashua Title I Preschool	0.683	0.180	0.106	0.029	0.001
25	NH000812	Nashua HS South/Purp Panthers Preschool	0.686	0.179	0.105	0.029	0.001
26	NH000813	Nashua Christian Academy	0.684	0.180	0.106	0.029	0.001
27	NH000814	Nashua Catholic Regional Jr. High	0.770	0.144	0.070	0.016	0.000
28	NH000815	Mt. Pleasant School	0.683	0.180	0.107	0.030	0.001

Functionality of Essential Facilities - Hospitals



Hospital Functionality

October 9, 2018



	Total # of Beds	At Day 1		At day 3		At day 7		At day 30		At day 90	
		# of Beds	%	# of Beds	%	# of Beds	%	# of Beds	%	# of Beds	%
New Hampshire											
Hillsborough			73.76		74.09		88.22		97.80		98.70
Large Hospital	396	195	49.20	197	49.80	288	72.85	369	93.25	380	96.00
Small Hospital	20	14	70.30	14	70.70	17	86.60	20	98.10	20	98.80

Study Region : NASHUA_EQ
 Scenario : Central_NH_65

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Earthquake Essential Facility Performance Information Also Available For:

- **Transportation Infrastructure –
Highways, Rail, Light Rail, Bus, Ports,
Ferry, Airports**
- **Utilities – Potable Water, Waste Water.
Oil System, Natural Gas, Electric Power,
Communications**
- **User Defined Facilities**

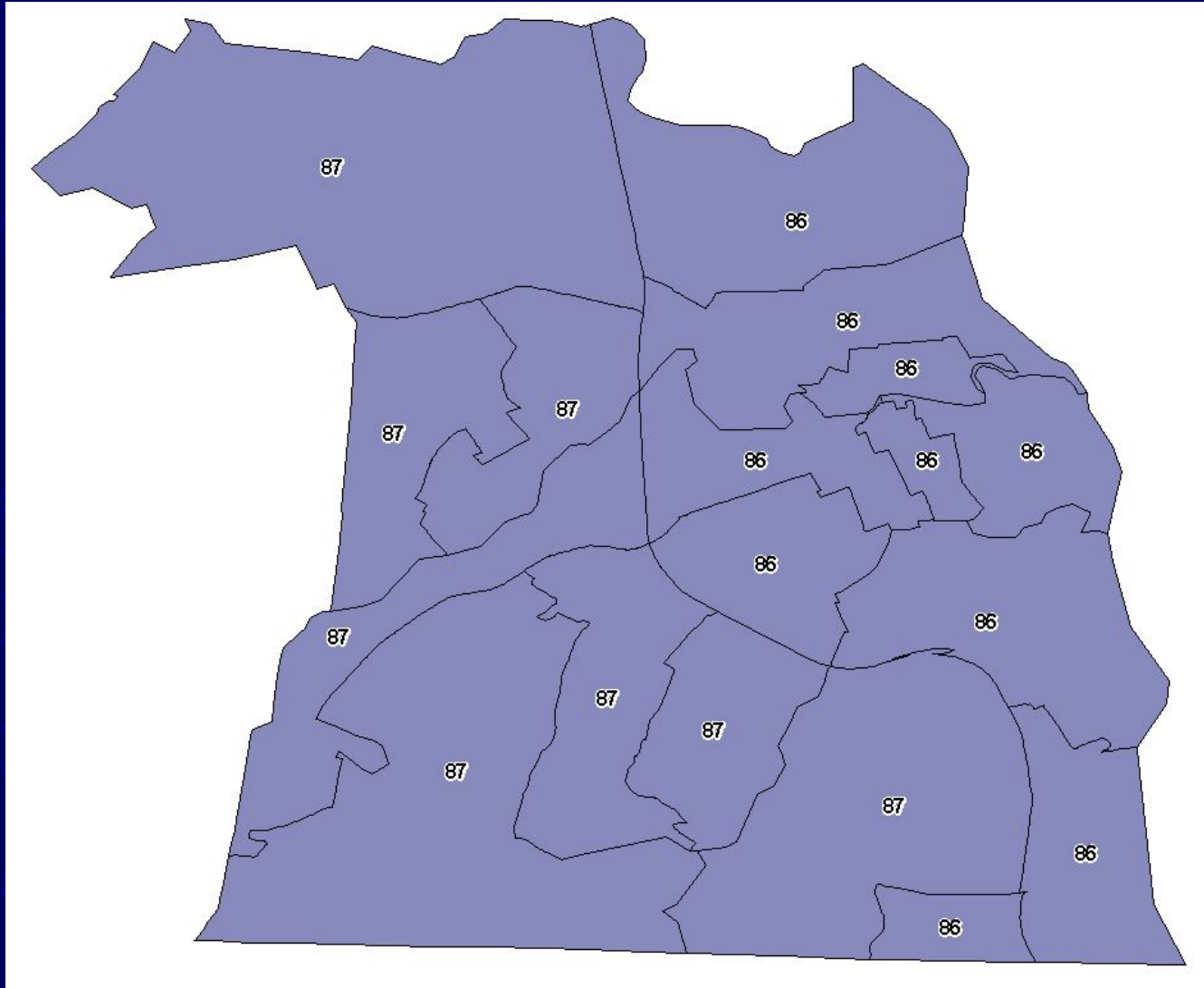
HURRICANE



1938 Hurricane



Peak Gusts – 1938 Hurricane



HAZUS Hurricane Specific Building & Structure Performance Outputs

- **Loss of Use Days**
- **Probability of Damage: Minor, Moderate, Severe & Destructive**

Functionality and Probability of Damage Essential Facilities – Schools

Medical Care Facilities Fire Stations Police Stations Emergency Response Centers Schools

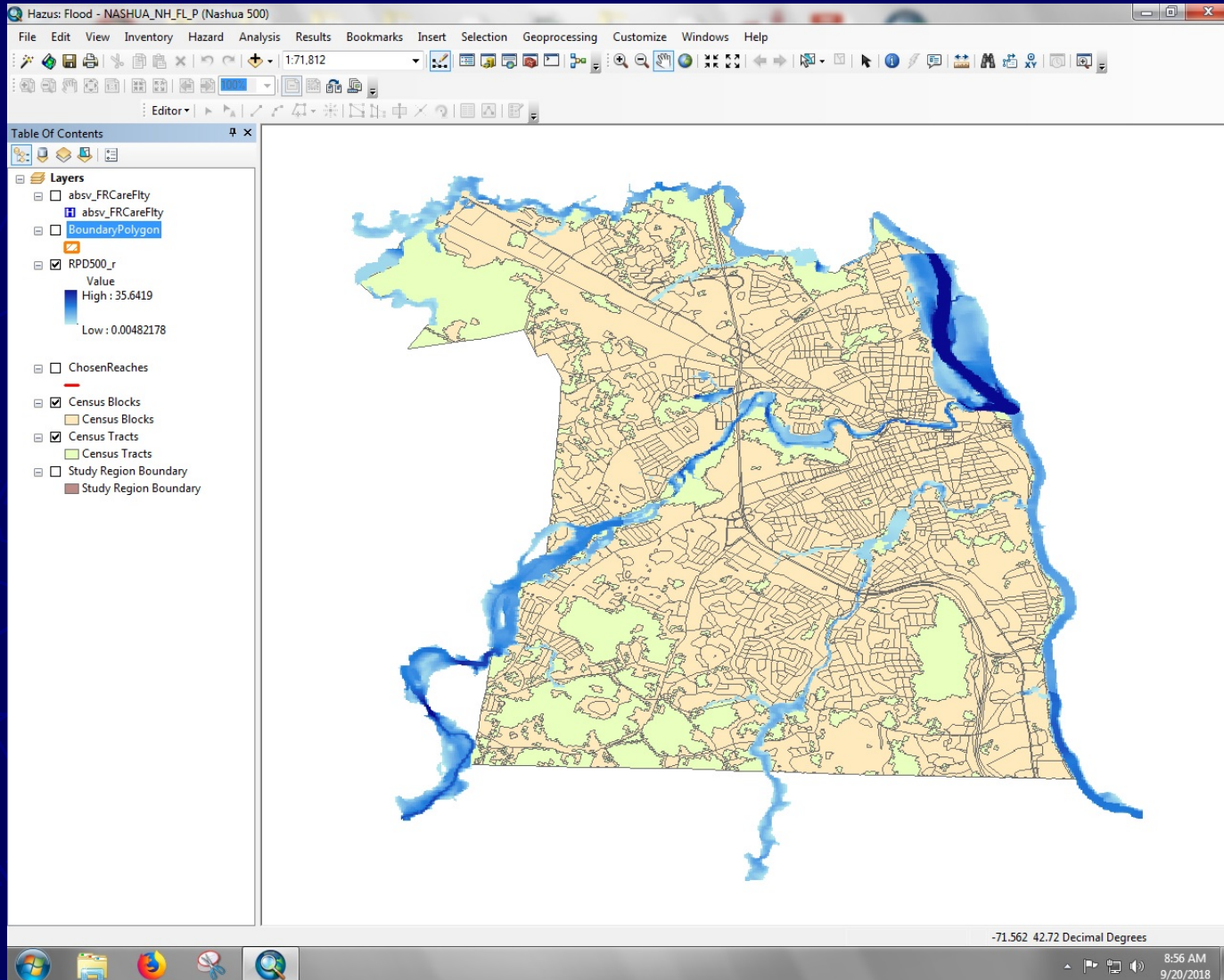
Table:

	ID	Name	Class	Loss Of Use (days)	Minor	Moderate	Severe	Destruction
1	NH0007	Nashua HS Nort	EFS1	0	0.03	0.00	0.00	0.00
2	NH0007	Birch Hill Elem S	EFS1	0	0.02	0.00	0.00	0.00
3	NH0007	Broad Street Ele	EFS1	0	0.03	0.00	0.00	0.00
4	NH0007	Charlotte Ave El	EFS1	0	0.02	0.00	0.00	0.00
5	NH0007	Mt. Pleasant Sch	EFS1	0	0.03	0.00	0.00	0.00
6	NH0007	Elm Street Middl	EFS1	0	0.03	0.00	0.00	0.00
7	NH0007	Ledge Street Sc	EFS1	0	0.03	0.00	0.00	0.00
8	NH0007	Fairgrounds Mid	EFS1	0	0.02	0.00	0.00	0.00
9	NH0007	Fairgrounds Elen	EFS1	0	0.02	0.00	0.00	0.00
10	NH0007	Sunset Heights S	EFS1	0	0.02	0.00	0.00	0.00
11	NH0007	New Searles Sch	EFS1	0	0.03	0.00	0.00	0.00
12	NH0007	Nashua HS Sou	EFS1	0	0.03	0.01	0.00	0.00
13	NH0008	Nashua Christi	EFS1	0	0.03	0.00	0.00	0.00
14	NH0008	St. Christopher S	EFS1	0	0.02	0.00	0.00	0.00
15	NH0008	Nashua Catholic	EFS1	0	0.02	0.00	0.00	0.00
16	NH0008	Infant Jesus Sch	EFS1	0	0.03	0.00	0.00	0.00
17	NH0008	Nashua Title I Pl	EFS1	0	0.03	0.00	0.00	0.00
18	NH0008	Acad for Scienc	EFS1	0	0.03	0.00	0.00	0.00
19	NH0008	Bicentennial Ele	EFS1	0	0.02	0.00	0.00	0.00
20	NH0008	World Academy	EFS1	0	0.02	0.00	0.00	0.00
21	NH0008	Main Dunstable	EFS1	0	0.02	0.00	0.00	0.00
22	NH0008	Bishop Guertin H	EFS1	0	0.02	0.00	0.00	0.00
23	NH0008	Amherst Street S	EFS1	0	0.02	0.00	0.00	0.00

FLOOD



500 Year Flood (FEMA Requirement for Critical & Essential Facilities)



HAZUS Flood Specific Building and Structure Performance Outputs

- **Building & Contents Damage (Percent)**
- **Functional or Non-Functional**
- **Days to 100% Functionality (Results can vary)**

Functionality of Essential Facilities Medical

Essential Facilities

Medical Care Facilities: Emergency Centers Schools

Results for
Scenario: Nashua 500

	FacilityName	EfClass	Description	ControllingHazard	BldgDmgPct	ContDmgPct	BldgLossUSD	ContLossUSD	NonFunctional
1	QUEST DIAGNOSTICS-300 MAIN ST	EFMC	Medical Clinics and Labs	R	2.94	2.94	0.00	0.00	<input type="checkbox"/>

Functionality of Utility Infrastructure Waste Water

Utility Systems Damage/Economic Loss

Potable Water Waste Water Oil Natural Gas Electric Power Communications

Results for
Scenario: Nashua 500

Table Type: Waste Water Lift Stations

	WasteWaterFtyId	FacilityName	UtilFcltyClass	Description	DamagePct	LossUSD	NonFunctional
1	NH000082	FULTON ST PS	WLSS	Small Lift Stations (<	0.00	0.00	<input type="checkbox"/>
2	NH000096	THOREAUS LANDIN	WLSS	Small Lift Stations (<	40.00	0.00	<input checked="" type="checkbox"/>
3	NH000097	NORTHGATE SEWE	WLSS	Small Lift Stations (<	40.00	0.00	<input checked="" type="checkbox"/>
4	NH000098	HOLLIS LANDING PF	WLSS	Small Lift Stations (<	0.00	0.00	<input type="checkbox"/>
5	NH000105	HOLLIS CROSSING I	WLSS	Small Lift Stations (<	0.00	0.00	<input type="checkbox"/>

How Can I Get HAZUS?

Download the latest version of Hazus **free-of-charge** online by visiting:

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