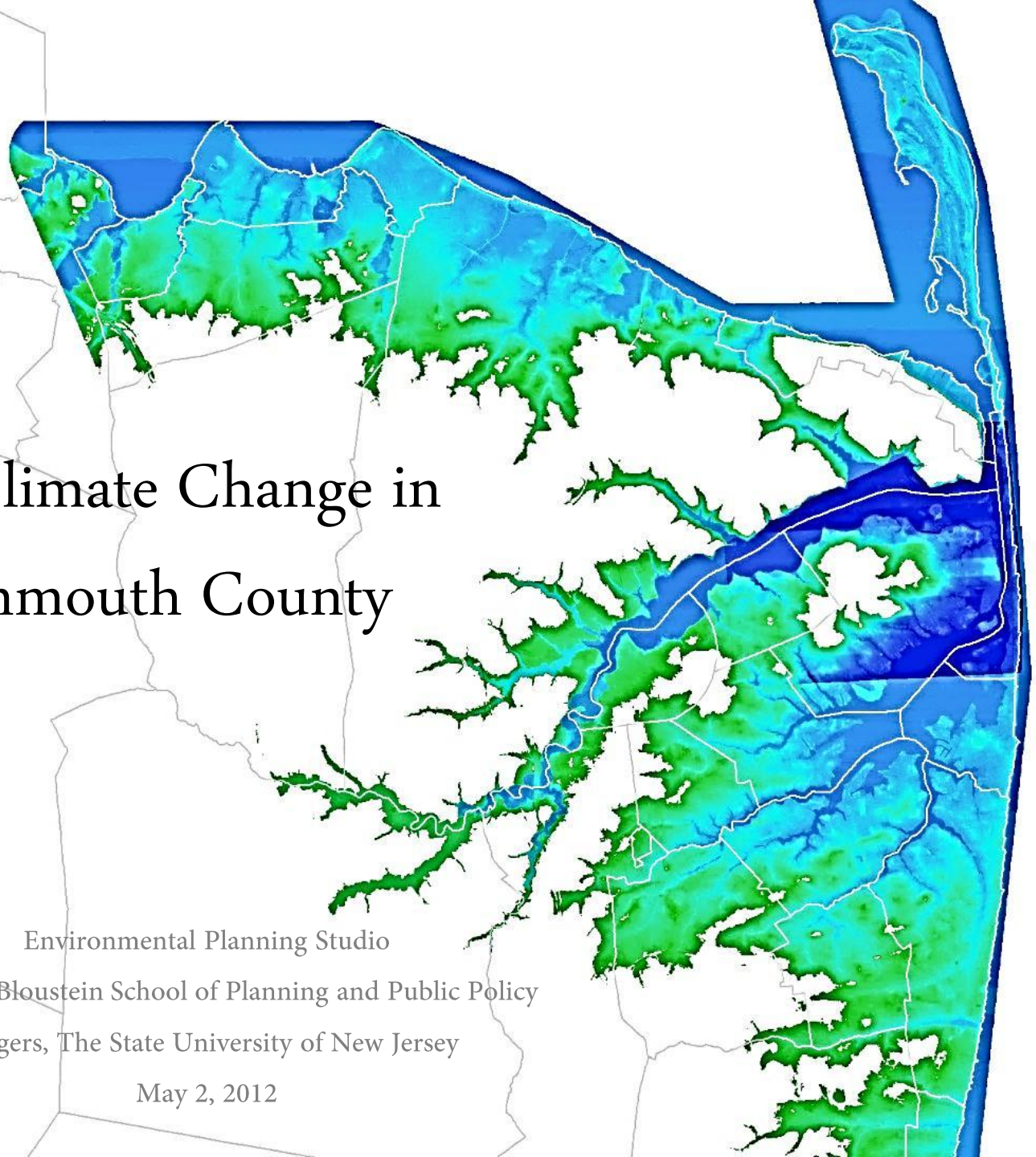
Adapting to Climate Change in Coastal Monmouth County



Environmental Planning Studio

Edward J. Bloustein School of Planning and Public Policy

Rutgers, The State University of New Jersey

May 2, 2012

Presentation Outline

- Introduction
- Best Practices
- Mitigation and Planning Regulations
- Case Study Overview
- Case Studies: Sea Bright, Highlands, Middletown
- Comparison of Case Studies
- Mitigation SWOT
- Conclusions

Municipal Case Study Historical Overview

- Dynamic, ever changing coast due to influences from currents and storms.
- 1890s- storms repeatedly destroyed wooden bulkheads and battered many of the cottages in Sea Bright.
- Christmas Storm and Jan. 1914 Storm- caused massive destruction.

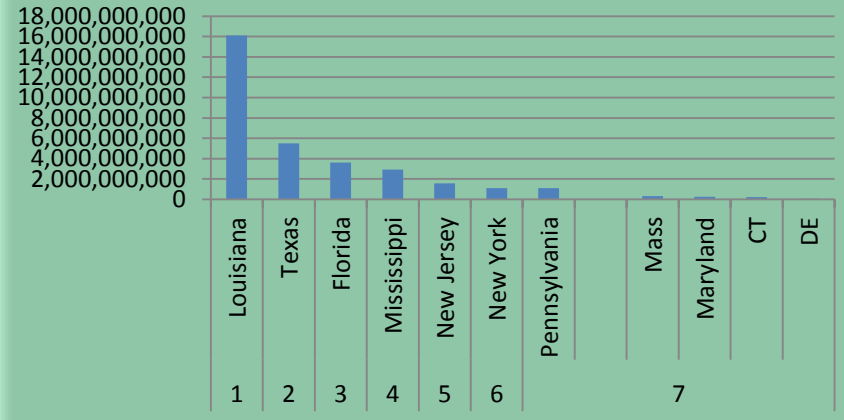
Municipal Case Historical Overview

- 1944- Great Atlantic Storm
- 1947- Sea wall built
- 1962 The Great Ash Wednesday Northeaster
- 1992 Northeaster
  - Impetus for beach replenishment- first round 1995
- 2001- second round of beach replenishment
- 2009- Tropical Storm Ida causes massive erosion
- 2011- Hurricane Irene

Responses to Notable Storm Events

Storm Event	Local Defensive Responses	Federal Law Enactment	State Law Enactment
1890's	First rock "wall" attempted at Sea Bright cottages rebuilt		
1913-14	Railroad retreated inland by a block; cottages abandoned,		1914 Waterfront Development Act
1944	Sea Bright Sea Wall built on former rail right of way		
1962—Noreaster	Houses built higher on stilts	**1968 NFIA – NFIP and FEMA Established** **1972 CZMA** followed by multiple updates, most notably 1990 Flood Disaster Protection Act of 1973	1970 NJ Wetlands Act **1973 CAFRA**
1992--Noreaster	Middletown Master Plan Adopted 2004	1994 Reform Act (NFIRA) of 1 2004 Flood Insurance Reform Act (FIRA) 2005 CZMA updated	**1993 CAFRA update**

NFIP Payouts 1978-Feb. 2012



Sea-Level Rise

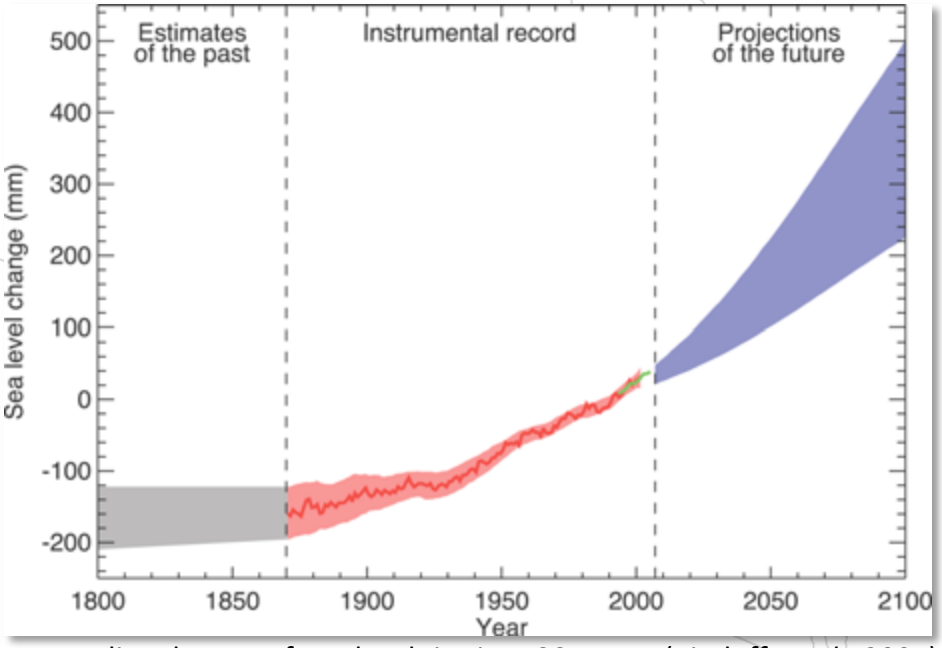
•Sea-level rise caused by Global Climate Change creates a displacement of the shoreline at all coastal margins, including those on the barrier islands, the baysides, and the mainland.

•In 2007, the IPCC estimated the projected median sea-level rise to be on the order of 0.6 to 1.2 meters in the next 100 years.

•The historic rates of median sea-level rise along the New Jersey coast range from 3-4 mm/yr.

•Projected rates of median sea-level rise in New Jersey are expected to increase to 6mm/yr.

Source: *(Psuty and Silveira, 2007)*



Predicted range of sea-level rise in IPCC report (Bindoff, *et al., 2007).*

Rates of sea-level rise derived from tidal records. (Psuty and Silveira, 2007)

Storm Surges and Sea-Level Rise

Storm Return Period	Probability of Occurrence				Base Flood Elevation	Base Flood Elevation (30-yrs SLR)
	1 year	7 years	15 years	30 years		
10-Yr Storm	10.0%	52.2%	79.4%	95.8%	7.0 ft	7.6 ft
50-Yr Storm	2.0%	13.2%	26.1%	45.5%	9.6 ft	10.2 ft
100-Yr Storm	1.0%	6.8%	14.0%	26.0%	10.9 ft	11.5 ft
500-Yr Storm	0.2%	1.4%	3.0%	5.8%	13.4 ft	14.0 ft

As sea-level rises, the effects of storms produce greater inundations and are able to reach farther inland. Smaller storms, which were of little concern before, now reach levels and locations which were attained rarely in the past. (Psuty and Silveira, 2007)

Modeling Flooding

HAZUS MH
EARTHQUAKE • WIND • FLOOD

"Hazus is a nationally applicable standardized methodology that contains models for estimating potential losses from earthquakes, floods, and hurricanes."

Hazus-MH uses Geographic Information Systems (GIS) technology to estimate physical, economic, and social impacts of disasters.

- **Physical damage** to residential and commercial buildings, schools, critical facilities, and infrastructure;

- **Economic loss**, including lost jobs, business interruptions, repair and reconstruction costs; and

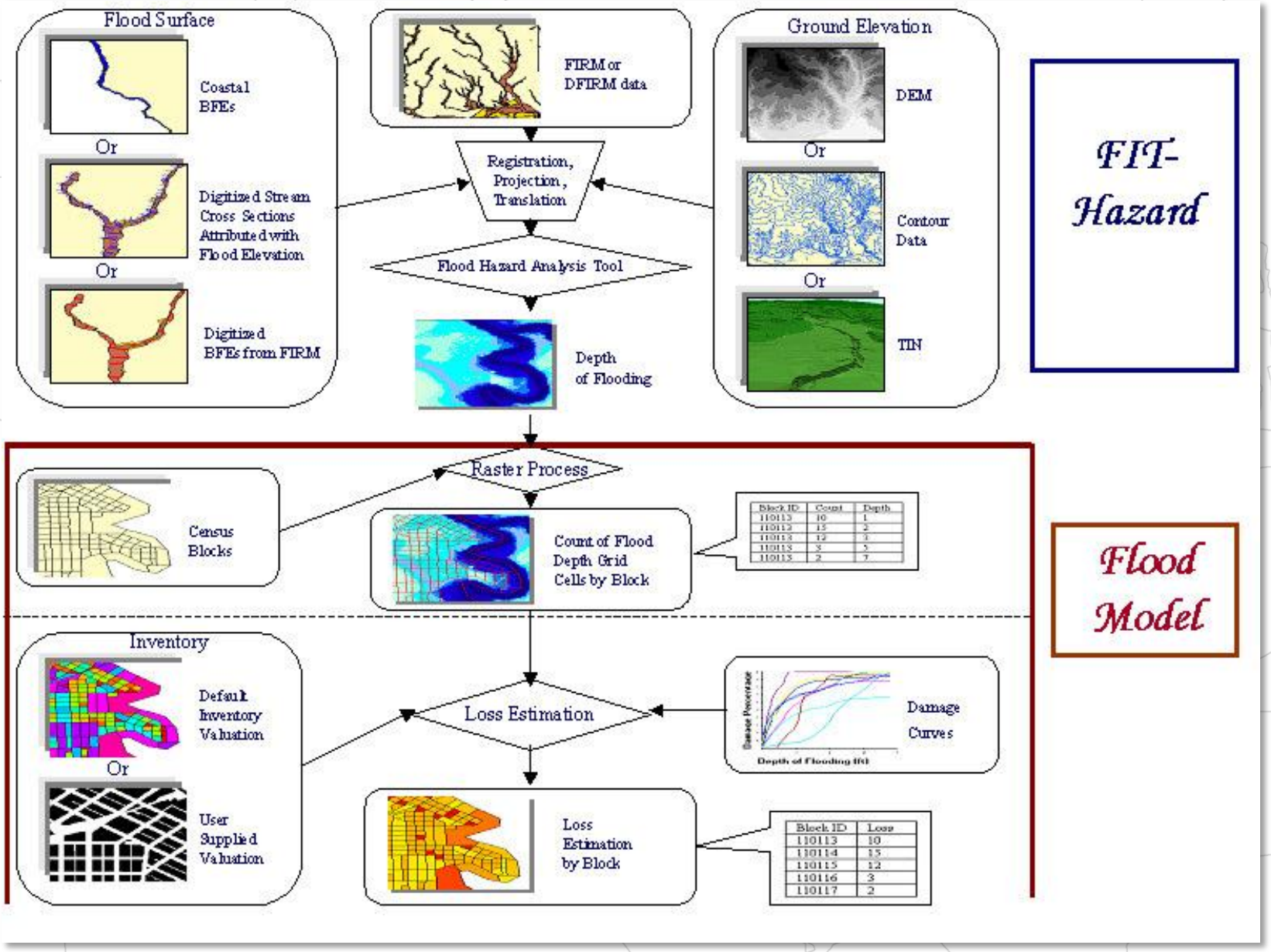
- **Social impacts**, including estimates of shelter requirements, displaced households, and population exposed to scenario floods, earthquakes, and hurricanes.

Source: FEMA, Hazus Methodology

FEMA

Hazus Methods

HAZUS uses hydrology models, Elevation data, FEMA FIRM Maps, 2000 Census data, and economic data to estimate losses based on predefined damage functions.



Refining the Flood Model

- The extent of flooding is modeled using FEMA's standardized Hazus methods and refined with LiDAR-based Digital Elevation Models.
- FEMA funded Light Detection And Ranging (LiDAR) data acquisition.
  - Collected from Dec. 2006 to Feb. 2007
  - 0.6ft vertical accuracy
  - 1 meter horizontal resolution

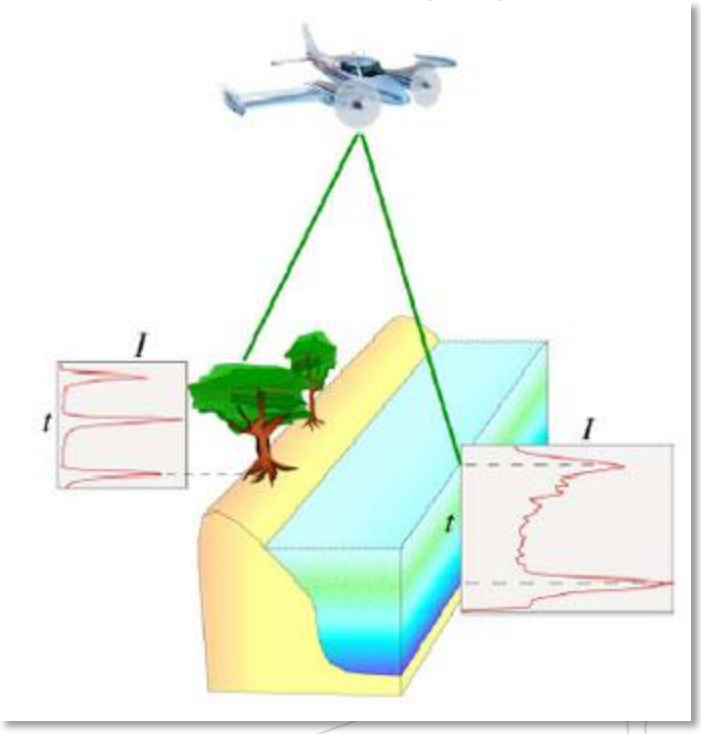
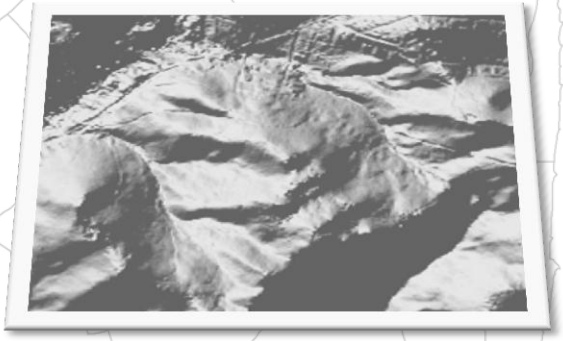
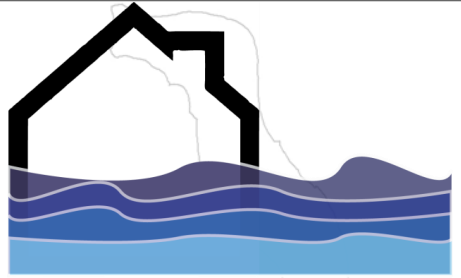


Photo Source: http://lidar.cr.usgs.gov/eaarl/



LiDAR-based DEM Hillshade

Transition



>50% Flooded = Substantially Damaged

HAZUS → FIA

Storms

Climate Change

Sea level rise

-Flooding
-Property damage
-Loss of business
-Loss of life

Impacts on municipal budgets

Mitigation-related decision making

Coastal management strategies

Property and Environment preservation

Fiscal Impact Analysis

Fiscal Impact Analysis estimates the net financial affect of storm events on municipalities' budgets

- Involves evaluation of tax revenues and expenditures associated with storm events

Revenues (+)

- Property Taxes ⬇
- State Aid ⬆
- Fees and Permits ➡
- Licenses ➡

Expenditures (-)

- Public Safety ⬆
- Administrative ➡
- Parks, Recreation, and Culture ⬆
- Public Works ⬆
- Storm-related Debris Disposal Costs ⬆
- Capital Costs of Infrastructure ⬆

Net: Revenues and expenditures are calculated to determine the net impact of a storm on a municipality's budget

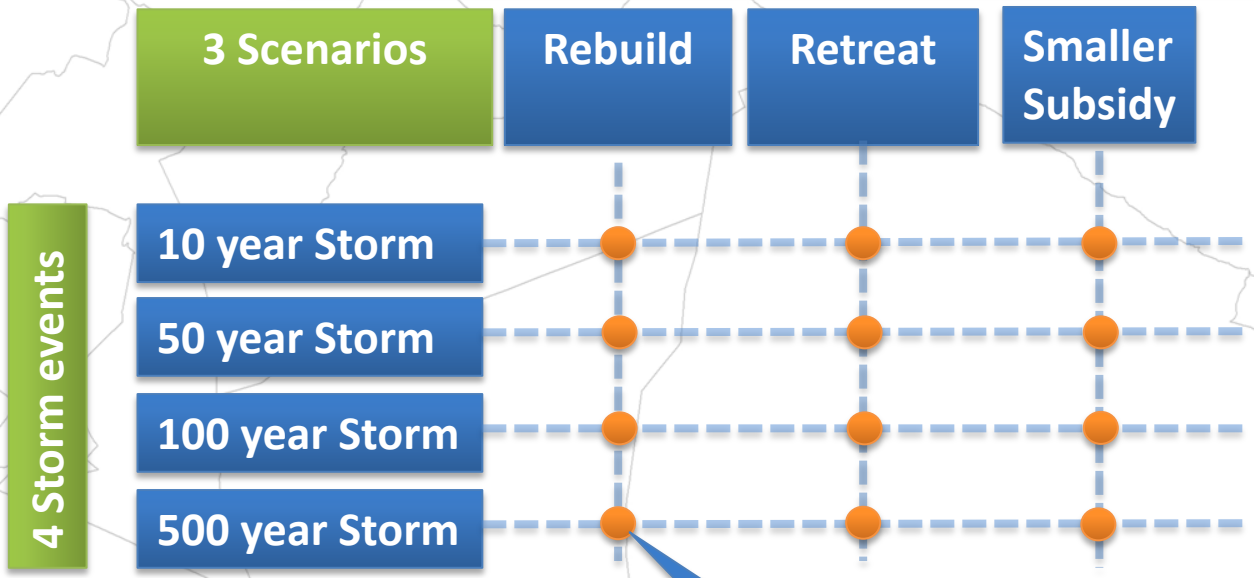
Fiscal Impact Analysis

Three components of a fiscal impact analysis:

1. Municipal
2. County
3. Schools

*Note: Only the municipal component of a fiscal impact analysis is analyzed in this presentation

Fiscal Impact Analysis Assumptions



Assumptions

- Expenditure Change
  - Public Safety
  - Relocation & Debris
  - Insurance Premiums
  - Infrastructure
- Revenues Change
  - Assessed Value change
- Population & Worker change

Reasons for Choosing Case Study Municipalities

- **Economically Diverse:**

	Population	Median Income	Poverty Rate
Highlands	5,005	$78,869	12.3%
Middletown	66,522	$96,190	3%
Sea Bright	1,412	$74,236	4.8%

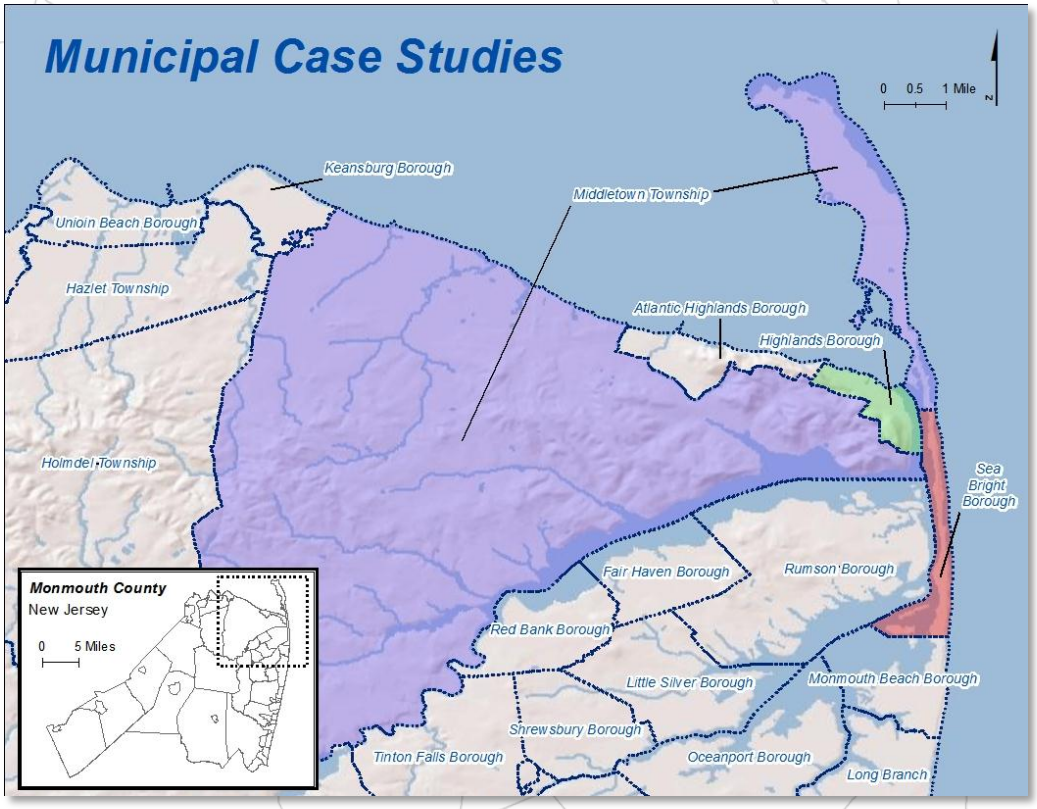
Source: US Census 2010

- **Unique Characteristics:**

  Middletown—large land area, subject to bayshore and riverine flooding;

  Highlands—bisected by steep slope into bayshore floodplain and plateau;

  Sea Bright—low lying commercial district on coastal barrier island and is protected by seawall.



Case Study: Highlands

- Highlands consists of a low lying floodplain and a plateau that sits high above the shore
- Unfortunately, the town's central business district (CBD) is located along Bay Avenue in the low-lying floodplain. This area is very flood-prone and even 10-year floods inundate this area quite easily
- 2004 Master Plan acknowledges the problem but appears to offer little in the way of solutions

Current Conditions

Highlands Borough, NJ

0 0.25 0.5 0.75 1 Miles

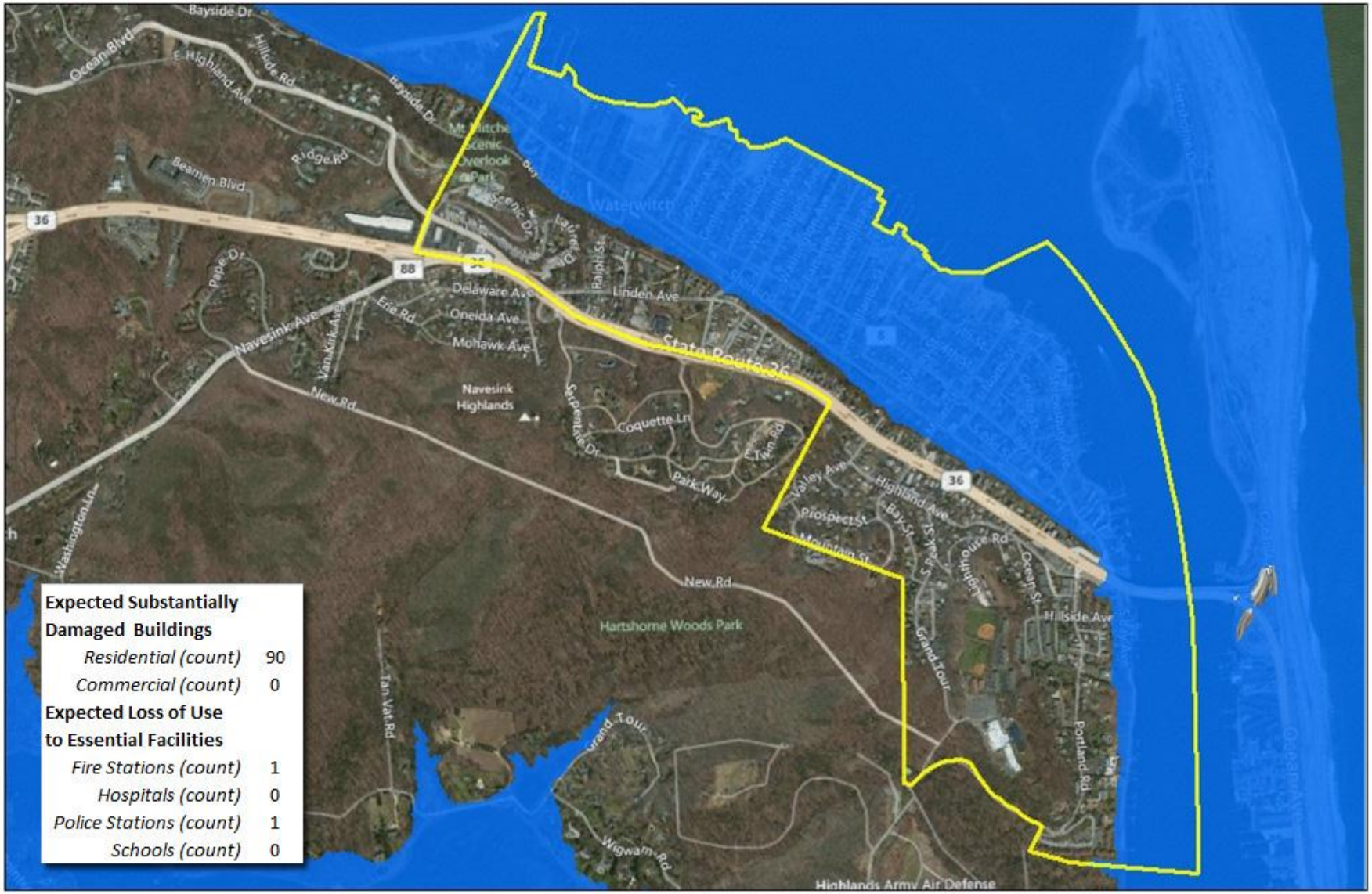
N

The extent of flooding is modeled using FEMA's standardized Hazus methods and LiDAR-based Digital Elevation Models with a horizontal accuracy of 1 meter and a vertical accuracy of 0.6 ft.

Source: NJDEP, FEMA, & Bing Maps Hybrid

10-Yr Storm

Highlands Borough, NJ



Expected Substantially Damaged Buildings	
Residential (count)	90
Commercial (count)	0
Expected Loss of Use to Essential Facilities	
Fire Stations (count)	1
Hospitals (count)	0
Police Stations (count)	1
Schools (count)	0

0 0.25 0.5 0.75 1 Miles

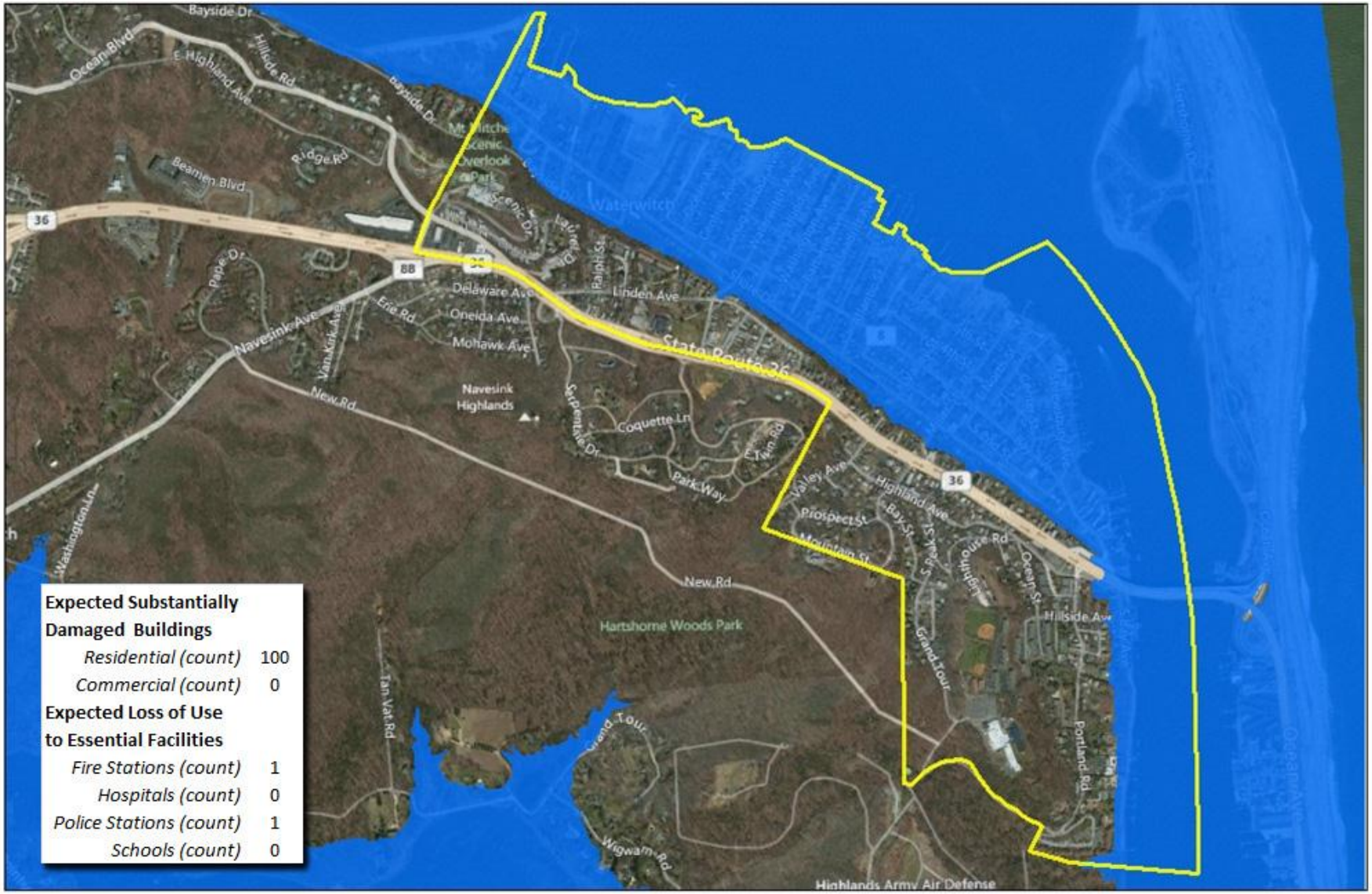
N

The extent of flooding is modeled using FEMA's standardized Hazus methods and LiDAR-based Digital Elevation Models with a horizontal accuracy of 1 meter and a vertical accuracy of 0.6 ft.

Source: NJDEP, FEMA, & Bing Maps Hybrid

50-Yr Storm

Highlands Borough, NJ



Expected Substantially Damaged Buildings	
Residential (count)	100
Commercial (count)	0
Expected Loss of Use to Essential Facilities	
Fire Stations (count)	1
Hospitals (count)	0
Police Stations (count)	1
Schools (count)	0

0 0.25 0.5 0.75 1 Miles

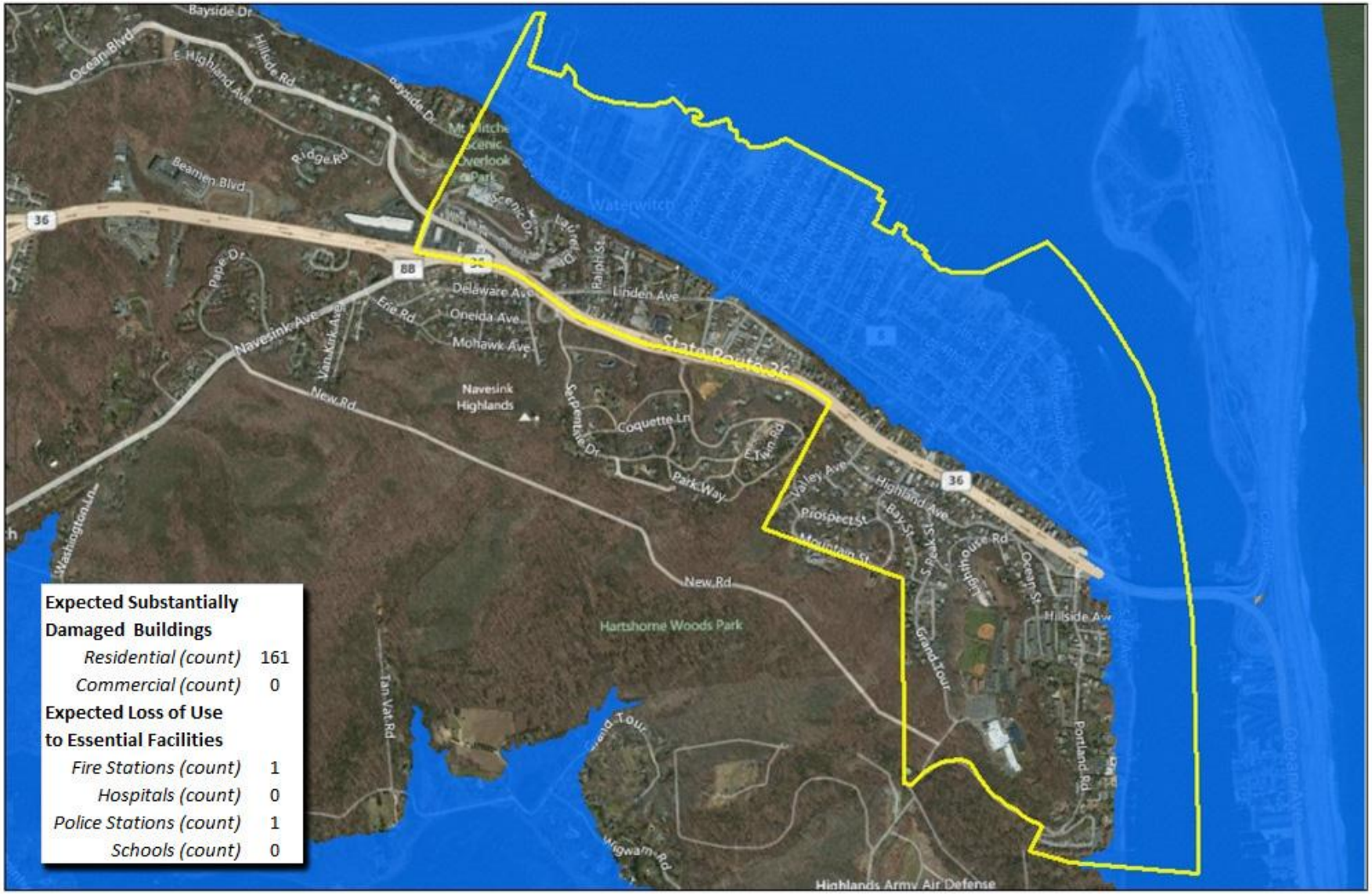
N

The extent of flooding is modeled using FEMA's standardized Hazus methods and LiDAR-based Digital Elevation Models with a horizontal accuracy of 1 meter and a vertical accuracy of 0.6 ft.

Source: NJDEP, FEMA, & Bing Maps Hybrid

100-Yr Storm

Highlands Borough, NJ



Expected Substantially Damaged Buildings	
Residential (count)	161
Commercial (count)	0
Expected Loss of Use to Essential Facilities	
Fire Stations (count)	1
Hospitals (count)	0
Police Stations (count)	1
Schools (count)	0

0 0.25 0.5 0.75 1 **Miles**

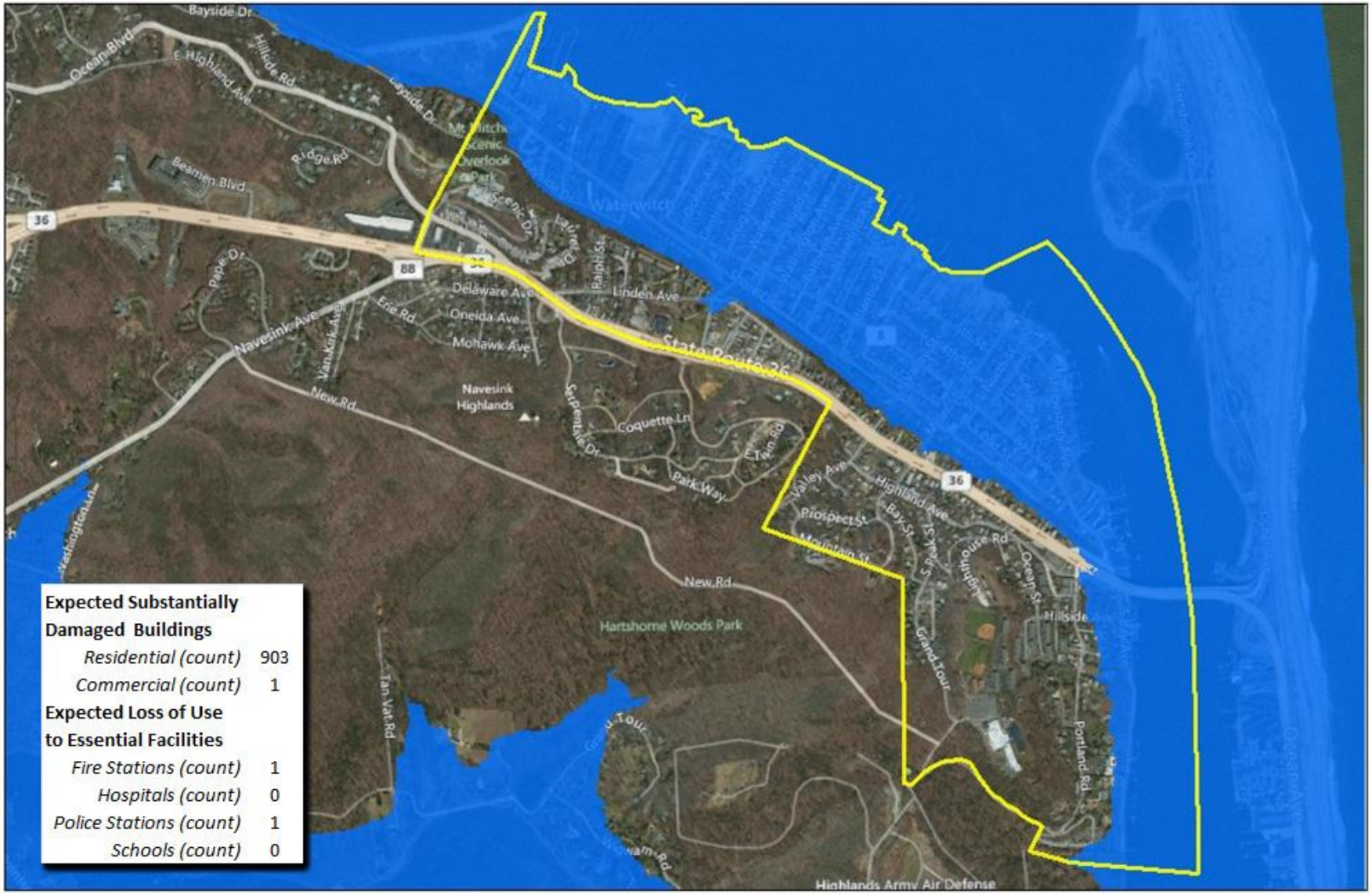
N

The extent of flooding is modeled using FEMA's standardized Hazus methods and LiDAR-based Digital Elevation Models with a horizontal accuracy of 1 meter and a vertical accuracy of 0.6 ft.

Source: NJDEP, FEMA, & Bing Maps Hybrid

500-Yr Storm

Highlands Borough, NJ



Expected Substantially Damaged Buildings	
Residential (count)	903
Commercial (count)	1
Expected Loss of Use to Essential Facilities	
Fire Stations (count)	1
Hospitals (count)	0
Police Stations (count)	1
Schools (count)	0

0 0.25 0.5 0.75 1 Miles

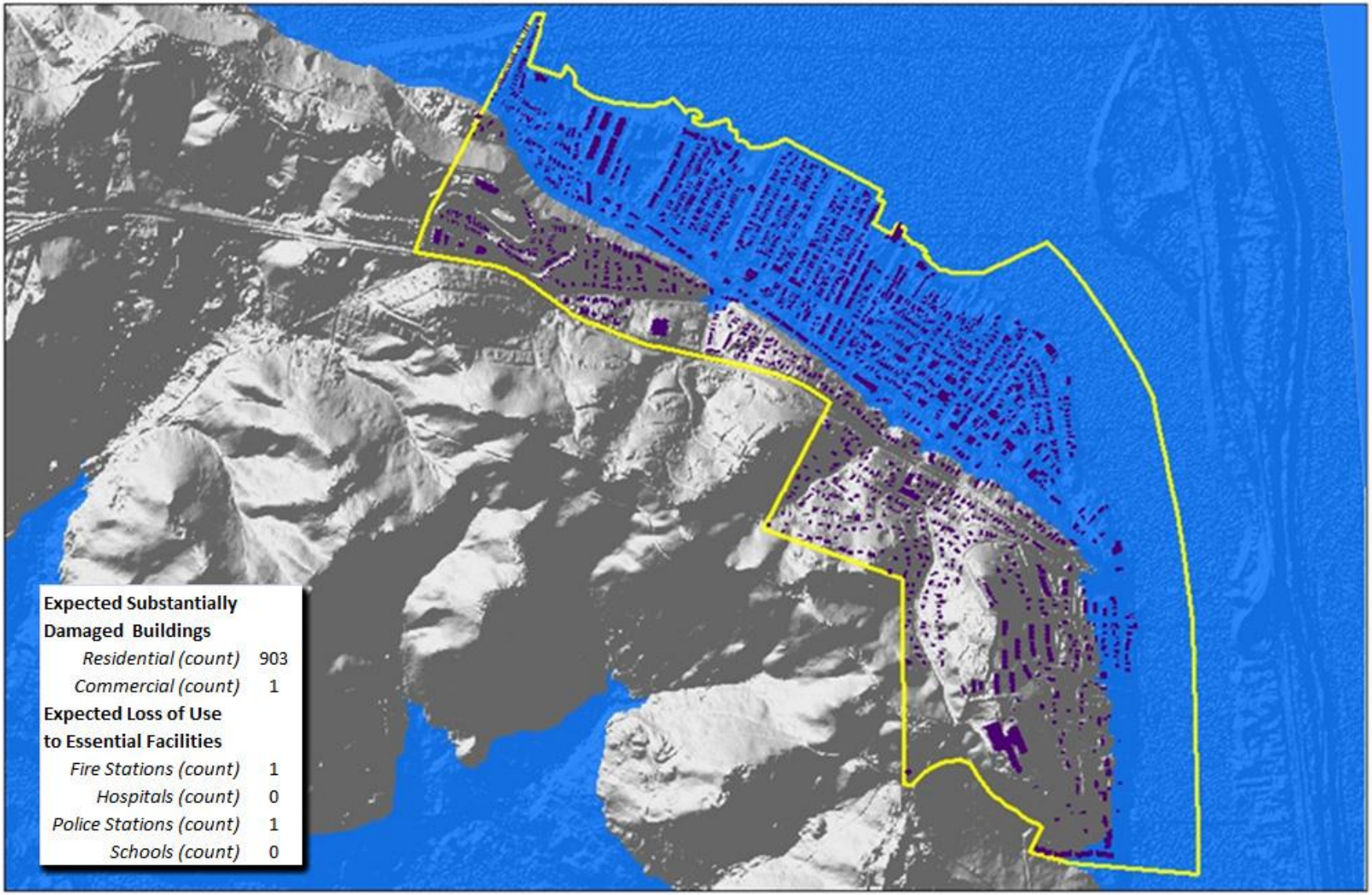
N

The extent of flooding is modeled using FEMA's standardized Hazus methods and LiDAR-based Digital Elevation Models with a horizontal accuracy of 1 meter and a vertical accuracy of 0.6 ft.

Source: NJDEP, FEMA, & Bing Maps Hybrid

500-Yr Storm

Highlands Borough, NJ



The extent of flooding is modeled using FEMA's standardized Hazus methods and LiDAR-based Digital Elevation Models with a horizontal accuracy of 1 meter and a vertical accuracy of 0.6 ft.

Source: NJDEP, FEMA, Monmouth County,& Bing Maps Hybrid

Highlands Fiscal Analysis

	2011 Budget	Rebuild	Retreat	Smaller Subsidy
10 Year Storm				
Expenditures	$8,099,675	$10,721,412	$10,412,460	$11,048,432
Revenues	$8,099,675	$8,099,675	$7,937,757	$8,018,716
Net Revenue	$0	-$2,621,736	-$2,474,703	-$3,029,716
Equalized Tax Rate	0.757	1.127	1.118	1.189
50 Year Storm				
Expenditures	$8,099,675	$11,541,115	$11,177,924	$12,278,524
Revenues	$8,099,675	$8,099,675	$7,919,766	$8,009,721
Net Revenue	$0	-$3,441,439	-$3,258,159	-$4,268,804
Equalized Tax Rate	0.757	1.238	1.229	1.361
100 Year Storm				
Expenditures	$8,099,675	$12,107,980	$11,485,413	$13,135,963
Revenues	$8,099,675	$8,099,675	$7,810,021	$7,954,848
Net Revenue	$0	-$4,008,304	-$3,675,392	-$5,181,115
Equalized Tax Rate	0.757	1.316	1.299	1.494
500 Year Storm				
Expenditures	$8,099,675	$12,789,486	$7,582,679	$12,105,907
Revenues	$8,099,675	$8,099,675	$6,469,763	$7,284,719
Net Revenue	$0	-$4,689,811	-$1,112,916	-$4,821,188
Equalized Tax Rate	0.757	1.409	0.990	1.541

Highlands Fiscal Analysis

	2011 Budget	Rebuild	Retreat	Smaller Subsidy
10 Year Storm				
Expenditures	$8,099,675	$10,721,412	$10,412,460	$11,048,432
Revenues	$8,099,675	$8,099,675	$7,937,757	$8,018,716
Net Revenue	$0	-$2,621,736	-$2,474,703	-$3,029,716
Equalized Tax Rate	0.757	1.127	1.118	1.189
50 Year Storm				
Expenditures	$8,099,675	$11,541,115	$11,177,924	$12,278,524
Revenues	$8,099,675	$8,099,675	$7,919,766	$8,009,721
Net Revenue	$0	-$3,441,439	-$3,258,159	-$4,268,804
Equalized Tax Rate	0.757	1.238	1.229	1.361
100 Year Storm				
Expenditures	$8,099,675	$12,107,980	$11,485,413	$13,135,963
Revenues	$8,099,675	$8,099,675	$7,810,021	$7,954,848
Net Revenue	$0	-$4,008,304	-$3,675,392	-$5,181,115
Equalized Tax Rate	0.757	1.316	1.299	1.494
500 Year Storm				
Expenditures	$8,099,675	$12,789,486	$7,582,679	$12,105,907
Revenues	$8,099,675	$8,099,675	$6,469,763	$7,284,719
Net Revenue	$0	-$4,689,811	-$1,112,916	-$4,821,188
Equalized Tax Rate	0.757	1.409	0.990	1.541

Highlands Fiscal Analysis

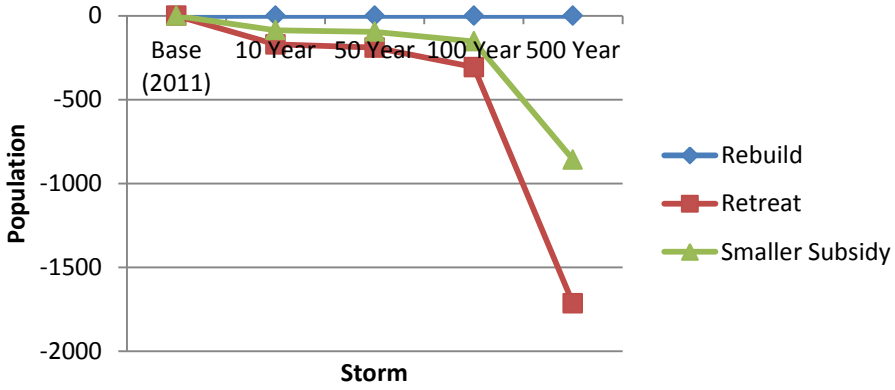
	2011 Budget	Rebuild	Retreat	Smaller Subsidy
10 Year Storm				
Expenditures	$8,099,675	$10,721,412	$10,412,460	$11,048,432
Revenues	$8,099,675	$8,099,675	$7,937,757	$8,018,716
Net Revenue	$0	-$2,621,736	-$2,474,703	-$3,029,716
Equalized Tax Rate	0.757	1.127	1.118	1.189
50 Year Storm				
Expenditures	$8,099,675	$11,541,115	$11,177,924	$12,278,524
Revenues	$8,099,675	$8,099,675	$7,919,766	$8,009,721
Net Revenue	$0	-$3,441,439	-$3,258,159	-$4,268,804
Equalized Tax Rate	0.757	1.238	1.229	1.361
100 Year Storm				
Expenditures	$8,099,675	$12,107,980	$11,485,413	$13,135,963
Revenues	$8,099,675	$8,099,675	$7,810,021	$7,954,848
Net Revenue	$0	-$4,008,304	-$3,675,392	-$5,181,115
Equalized Tax Rate	0.757	1.316	1.299	1.494
500 Year Storm				
Expenditures	$8,099,675	$12,789,486	$7,582,679	$12,105,907
Revenues	$8,099,675	$8,099,675	$6,469,763	$7,284,719
Net Revenue	$0	-$4,689,811	-$1,112,916	-$4,821,188
Equalized Tax Rate	0.757	1.409	0.990	1.541

Highlands Fiscal Analysis

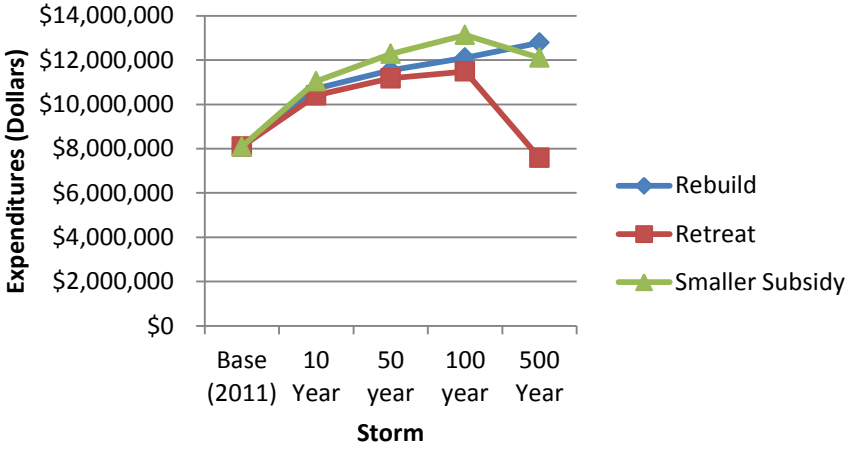
	2011 Budget	Rebuild	Retreat	Smaller Subsidy
10 Year Storm				
Expenditures	$8,099,675	$10,721,412	$10,412,460	$11,048,432
Revenues	$8,099,675	$8,099,675	$7,937,757	$8,018,716
Net Revenue	$0	-$2,621,736	-$2,474,703	-$3,029,716
Equalized Tax Rate	0.757	1.127	1.118	1.189
50 Year Storm				
Expenditures	$8,099,675	$11,541,115	$11,177,924	$12,278,524
Revenues	$8,099,675	$8,099,675	$7,919,766	$8,009,721
Net Revenue	$0	-$3,441,439	-$3,258,159	-$4,268,804
Equalized Tax Rate	0.757	1.238	1.229	1.361
100 Year Storm				
Expenditures	$8,099,675	$12,107,980	$11,485,413	$13,135,963
Revenues	$8,099,675	$8,099,675	$7,810,021	$7,954,848
Net Revenue	$0	-$4,008,304	-$3,675,392	-$5,181,115
Equalized Tax Rate	0.757	1.316	1.299	1.494
500 Year Storm				
Expenditures	$8,099,675	$12,789,486	$7,582,679	$12,105,907
Revenues	$8,099,675	$8,099,675	$6,469,763	$7,284,719
Net Revenue	$0	-$4,689,811	-$1,112,916	-$4,821,188
Equalized Tax Rate	0.757	1.409	0.990	1.541

Highlands Fiscal Analysis

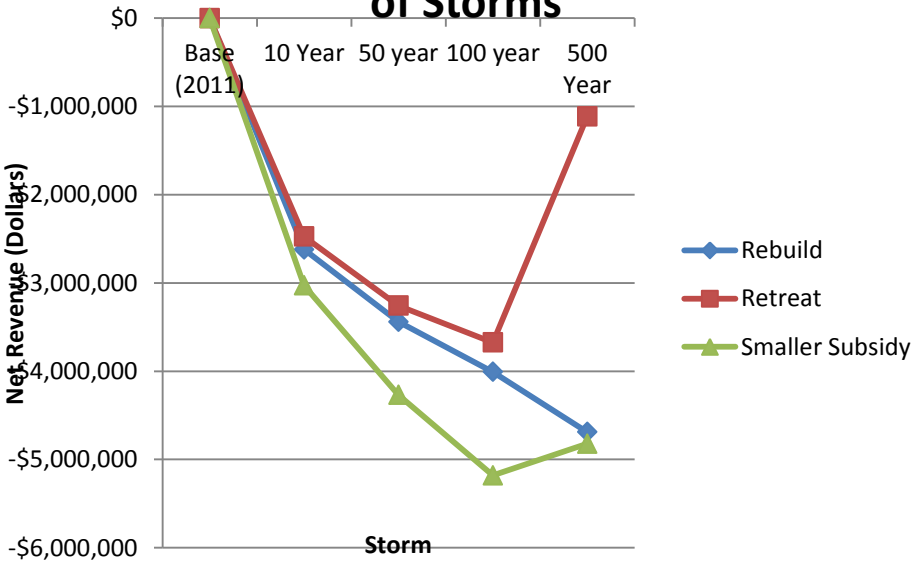
Highlands 2011: Population Loss Due to Storms



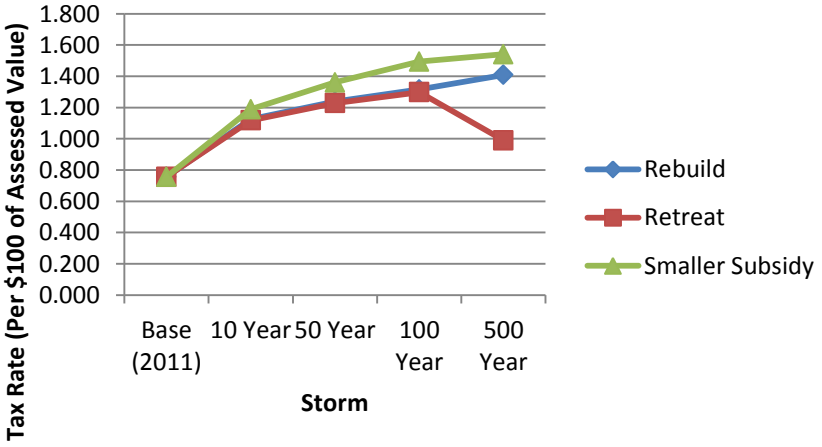
Highlands Expenditures in the Event of Storms



Highlands Net Revenues in the Event of Storms



Highlands' Equalized Tax Rate in Storm Events



Case Study: Middletown

1944 Riverine flooding, North Shrewsbury River

During the night of the 1944 hurricane, from her house on the northern bank of The North Shrewsbury River, June Methot saw that the river was 30' above the normal high tide line. *"Not until morning did we discover that a sturdy 100—foot dock, 50 to 60 feet of solid concrete bulkhead and one-third of our riverbank had vanished."* –Methot, June. Up & Down the River. Navesink, NJ: Whip Publishers, 1980.

1992 Coastal Flooding

"In Middletown , the hardest hit sections were Leonardo, Belford and Port Monmouth. In Port Monmouth, the township's new fishing pier, built with Green Acres funds and opened in August, suffered severe damage.

The Old Spy House, the first house built in New Jersey, suffered no visible damage, but an observation deck located over the dunes behind the old structure was pulled up during the storm and pushed into the neighboring fishing pier. Middletown Mayor Rosemarie Peters said the dunes that had protected the township's beach were destroyed and the beach itself suffered severe erosion.

"There's a lot of work to be done," Peters said. "We just had power returned to most of the township today."

2010 Hurricane Earl

Current Conditions

Middletown Township, NJ

0 1 2 3 4 Miles

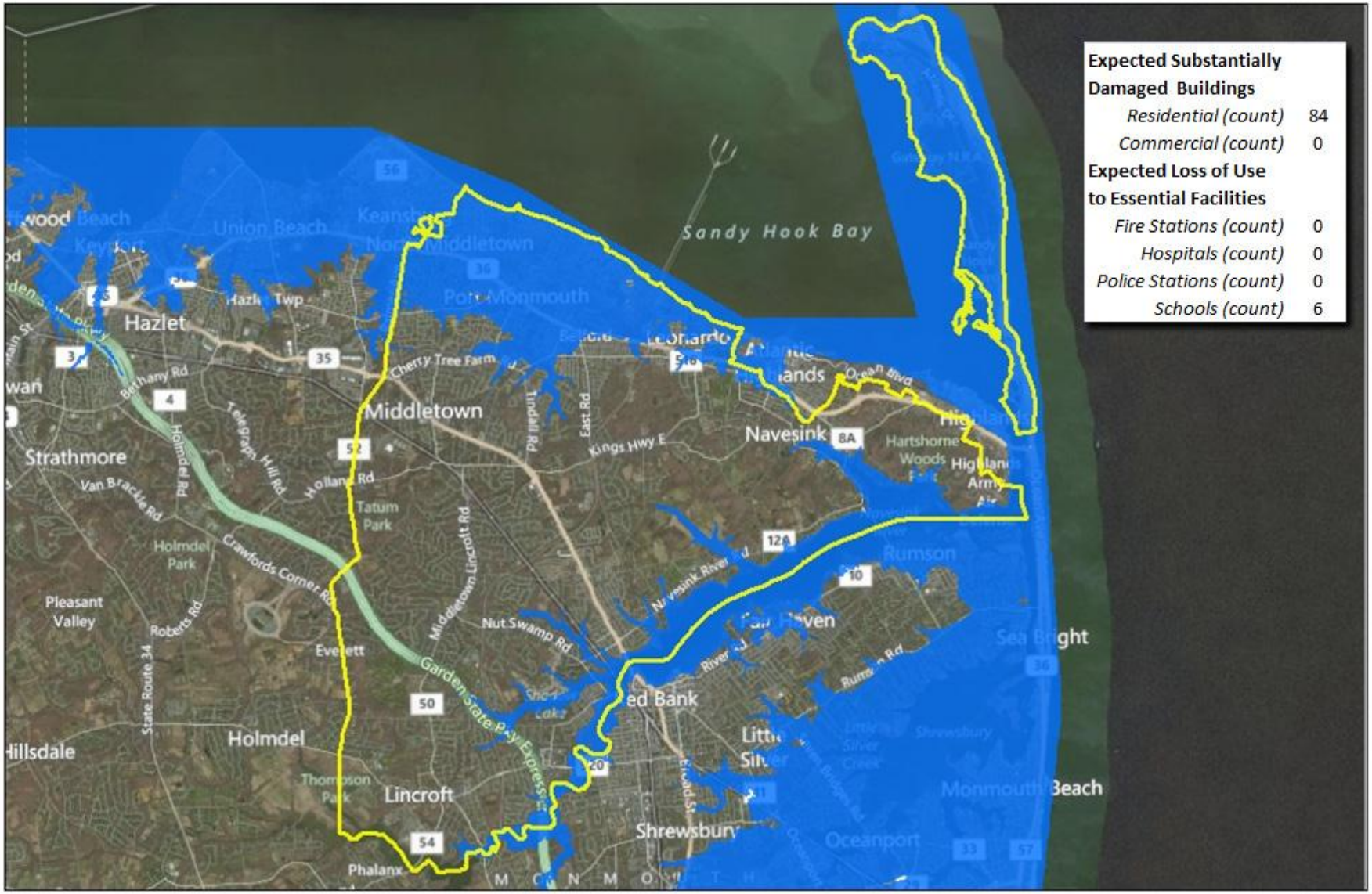
N

The extent of flooding is modeled using FEMA's standardized Hazus methods and LiDAR-based Digital Elevation Models with a horizontal accuracy of 1 meter and a vertical accuracy of 0.6 ft.

Source: NJDEP, FEMA, & Bing Maps Hybrid

10-Yr Storm

Middletown Township, NJ



Expected Substantially Damaged Buildings	
Residential (count)	84
Commercial (count)	0
Expected Loss of Use to Essential Facilities	
Fire Stations (count)	0
Hospitals (count)	0
Police Stations (count)	0
Schools (count)	6

0 1 2 3 4 **Miles**

N

The extent of flooding is modeled using FEMA's standardized Hazus methods and LiDAR-based Digital Elevation Models with a horizontal accuracy of 1 meter and a vertical accuracy of 0.6 ft.

Source: NJDEP, FEMA, & Bing Maps Hybrid

50-Yr Storm

Middletown Township, NJ

Expected Substantially Damaged Buildings	
Residential (count)	1,455
Commercial (count)	0
Expected Loss of Use to Essential Facilities	
Fire Stations (count)	0
Hospitals (count)	0
Police Stations (count)	0
Schools (count)	8

0 1 2 3 4 Miles

N

The extent of flooding is modeled using FEMA's standardized Hazus methods and LiDAR-based Digital Elevation Models with a horizontal accuracy of 1 meter and a vertical accuracy of 0.6 ft.

Source: NJDEP, FEMA, & Bing Maps Hybrid

100-Yr Storm

Middletown Township, NJ

The extent of flooding is modeled using FEMA's standardized Hazus methods and LiDAR-based Digital Elevation Models with a horizontal accuracy of 1 meter and a vertical accuracy of 0.6 ft.

Source: NJDEP, FEMA, & Bing Maps Hybrid

500-Yr Storm

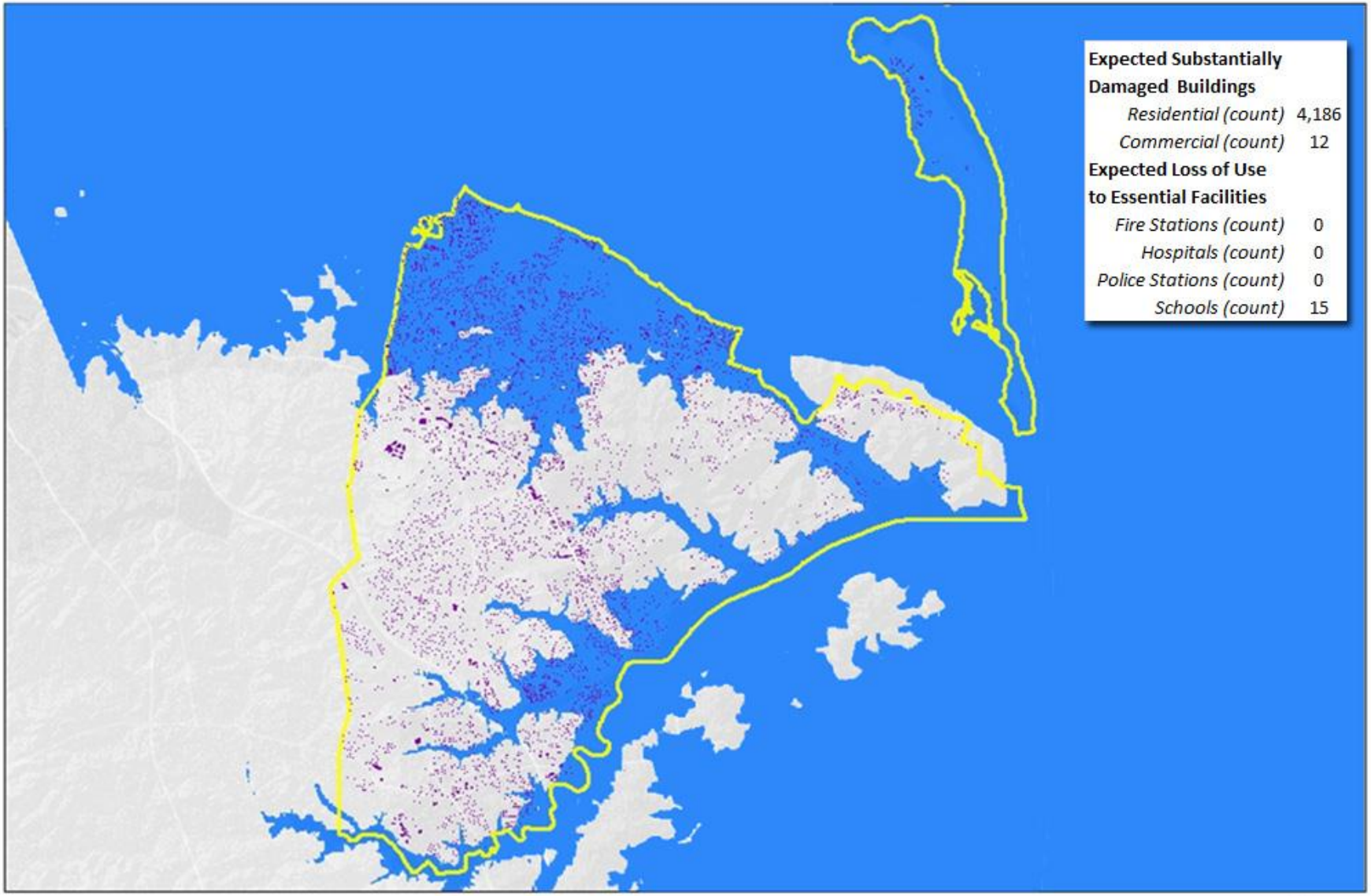
Middletown Township, NJ

The extent of flooding is modeled using FEMA's standardized Hazus methods and LiDAR-based Digital Elevation Models with a horizontal accuracy of 1 meter and a vertical accuracy of 0.6 ft.

Source: NJDEP, FEMA, & Bing Maps Hybrid

500-Yr Storm

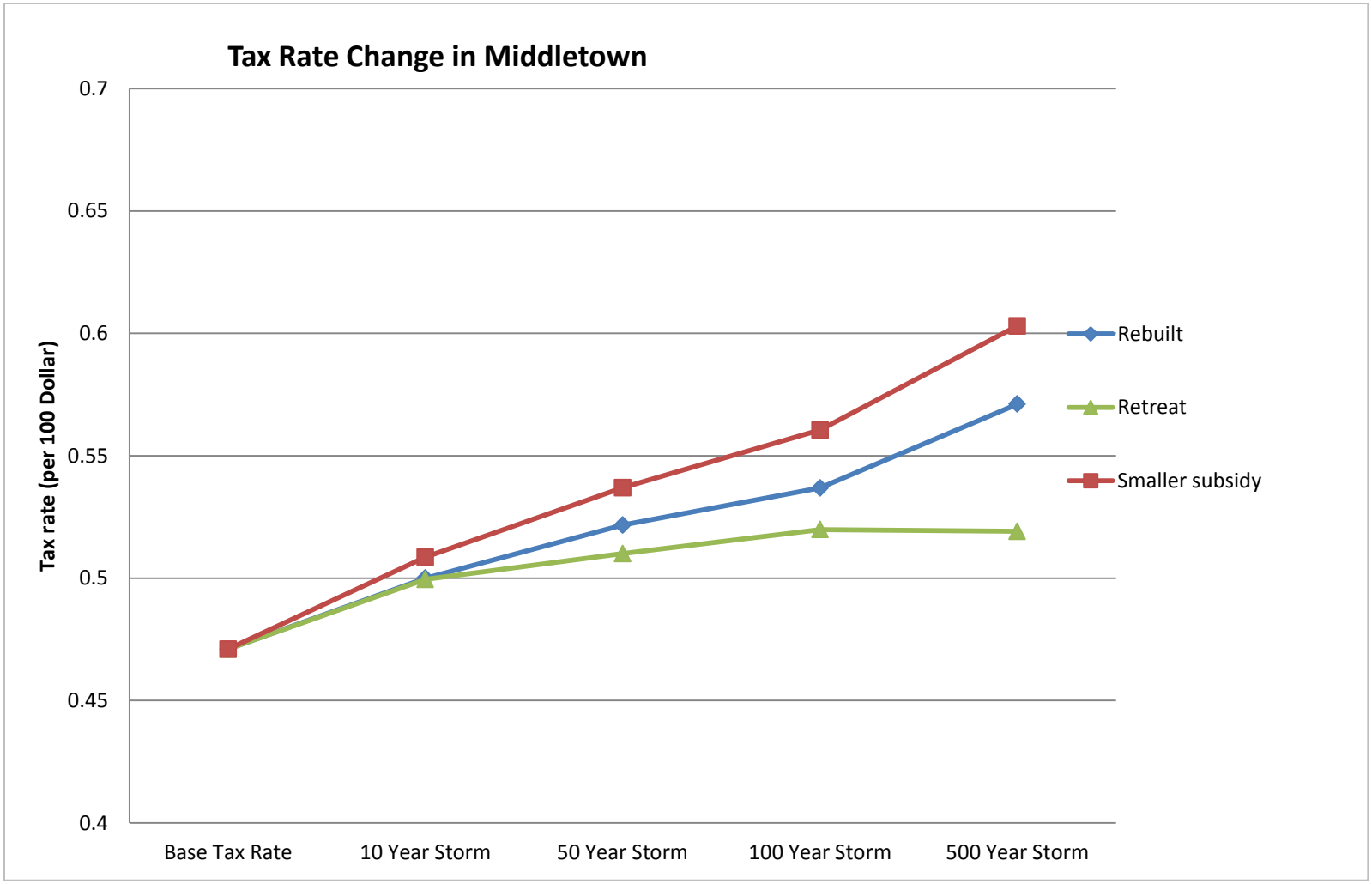
Middletown Township, NJ



The extent of flooding is modeled using FEMA's standardized Hazus methods and LiDAR-based Digital Elevation Models with a horizontal accuracy of 1 meter and a vertical accuracy of 0.6 ft.

Source: NJDEP, FEMA, Monmouth County,& Bing Maps Hybrid

Middletown Fiscal Analysis

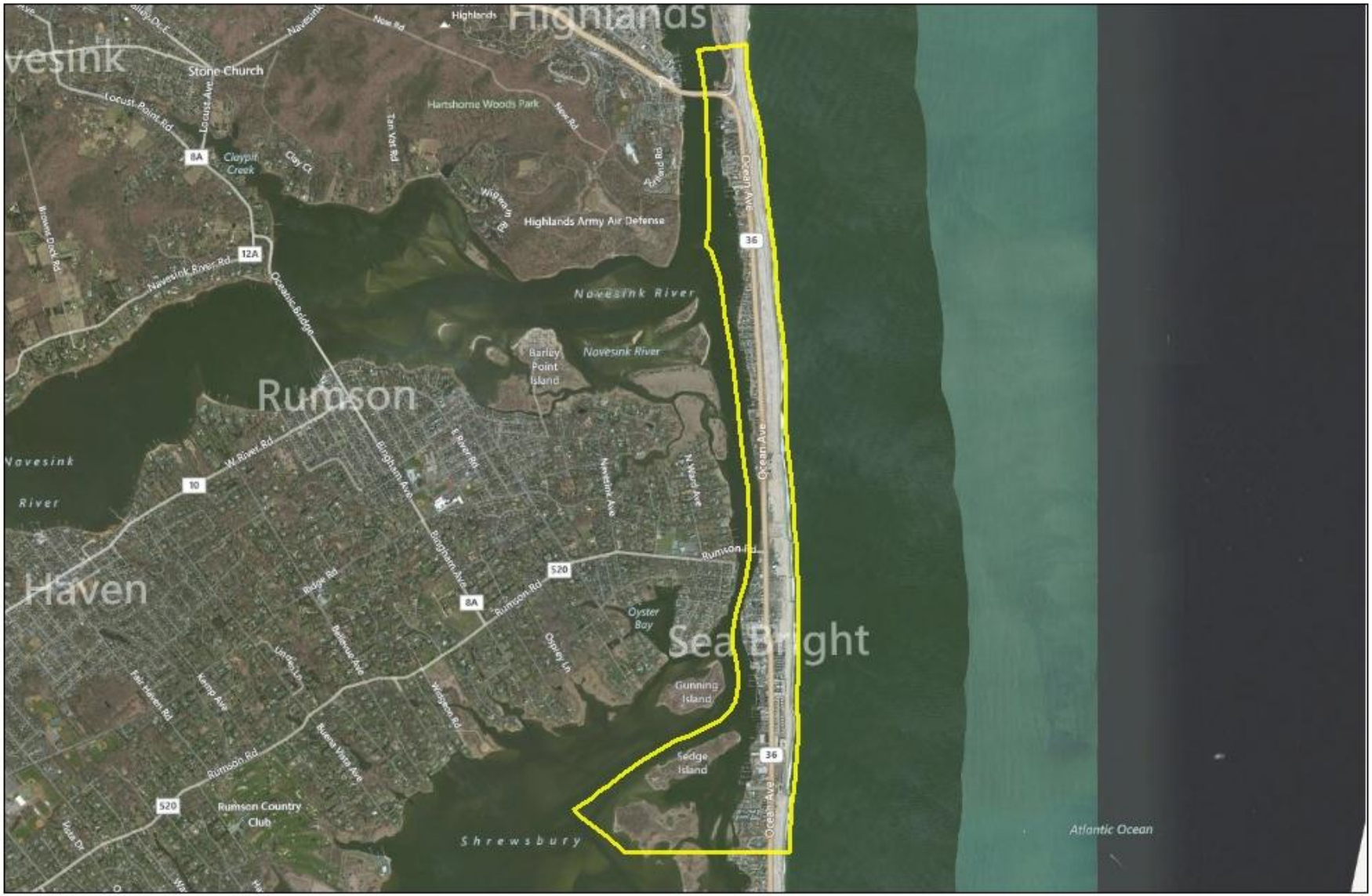


Case Study: Sea Bright

- Barrier spit bounded by the Shrewsbury River to the west and the Atlantic Ocean to the east.
- The downtown commercial area is located in the lowest lying part of the borough and is prone to severe riverine flooding during spring tide high tide events.
- Borough has severe erosion issues.
- 1947- construction of seawall.
- 1995- 1st phase of beach nourishment project.
- 2001- 2nd phase of beach renourishment.
- 2012- 3rd phase of beach renourishment.

Current Conditions

Sea Bright Borough, NJ



0 1 2 3 Miles

N

The extent of flooding is modeled using FEMA's standardized Hazus methods and LiDAR-based Digital Elevation Models with a horizontal accuracy of 1 meter and a vertical accuracy of 0.6 ft.

Source: NJDEP, FEMA, & Bing Maps Hybrid

10-Year Storm

Sea Bright Borough, NJ

Expected Substantially Damaged Buildings	
Residential (count)	0
Commercial (count)	0
Expected Loss of Use to Essential Facilities	
Fire Stations (count)	1
Hospitals (count)	0
Police Stations (count)	1
Schools (count)	0

0 1 2 3 **Miles**

N

The extent of flooding is modeled using FEMA's standardized Hazus methods and LiDAR-based Digital Elevation Models with a horizontal accuracy of 1 meter and a vertical accuracy of 0.6 ft.

Source: NJDEP, FEMA, & Bing Maps Hybrid

50-Year Storm

Sea Bright Borough, NJ

0 1 2 3 Miles

N

The extent of flooding is modeled using FEMA's standardized Hazus methods and LiDAR-based Digital Elevation Models with a horizontal accuracy of 1 meter and a vertical accuracy of 0.6 ft.

Source: NJDEP, FEMA, & Bing Maps Hybrid

100-Year Storm

Sea Bright Borough, NJ

Expected Substantially Damaged Buildings	
Residential (count)	21
Commercial (count)	1
Expected Loss of Use to Essential Facilities	
Fire Stations (count)	1
Hospitals (count)	0
Police Stations (count)	1
Schools (count)	0

0 1 2 3 **Miles**

N

The extent of flooding is modeled using FEMA's standardized Hazus methods and LiDAR-based Digital Elevation Models with a horizontal accuracy of 1 meter and a vertical accuracy of 0.6 ft.

Source: NJDEP, FEMA, & Bing Maps Hybrid

500-Year Storm

Sea Bright Borough, NJ

Expected Substantially Damaged Buildings	
Residential (count)	324
Commercial (count)	10
Expected Loss of Use to Essential Facilities	
Fire Stations (count)	1
Hospitals (count)	0
Police Stations (count)	1
Schools (count)	0

0 1 2 3 **Miles**

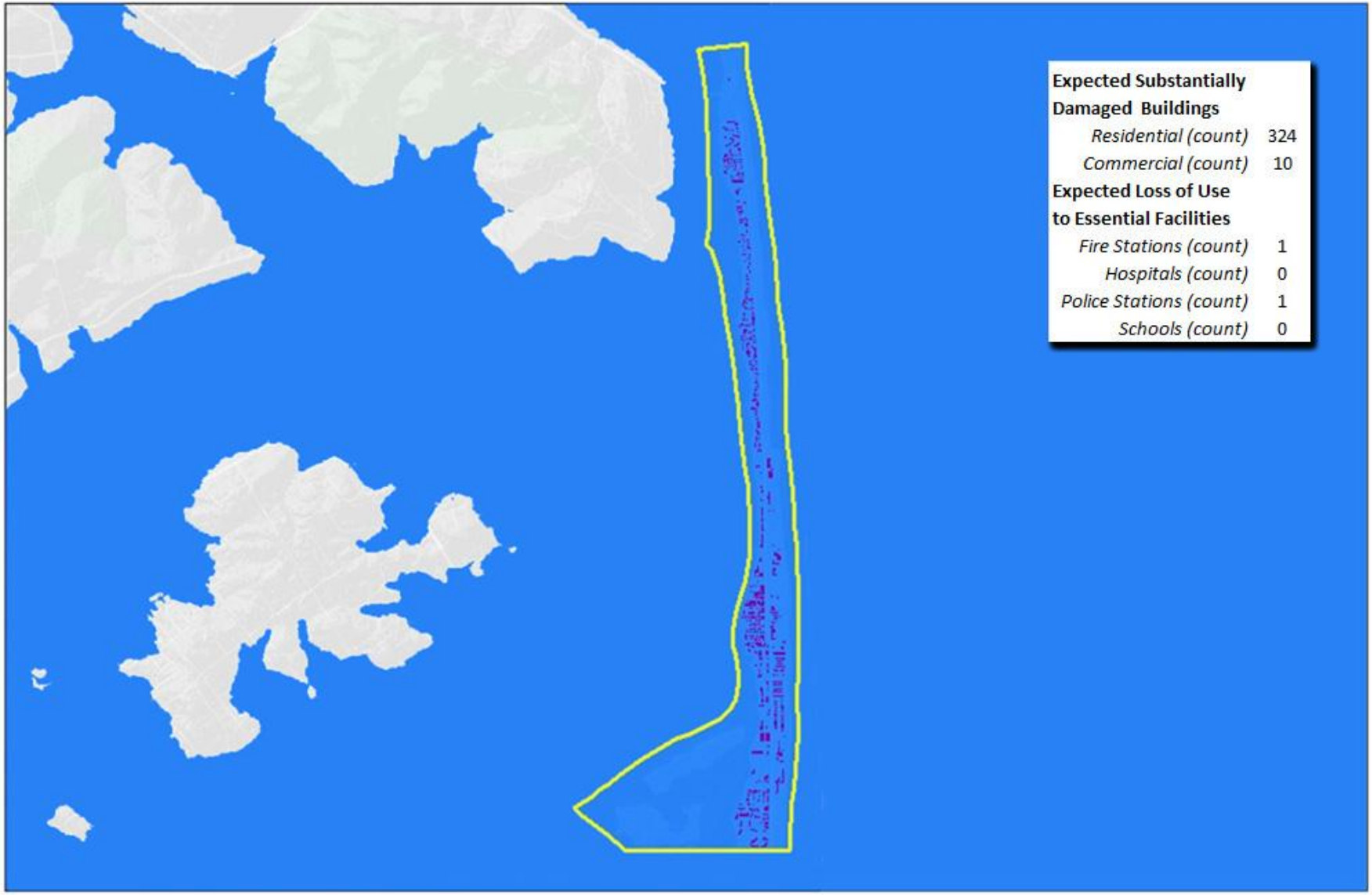
N

The extent of flooding is modeled using FEMA's standardized Hazus methods and LiDAR-based Digital Elevation Models with a horizontal accuracy of 1 meter and a vertical accuracy of 0.6 ft.

Source: NJDEP, FEMA, & Bing Maps Hybrid

500-Yr Storm

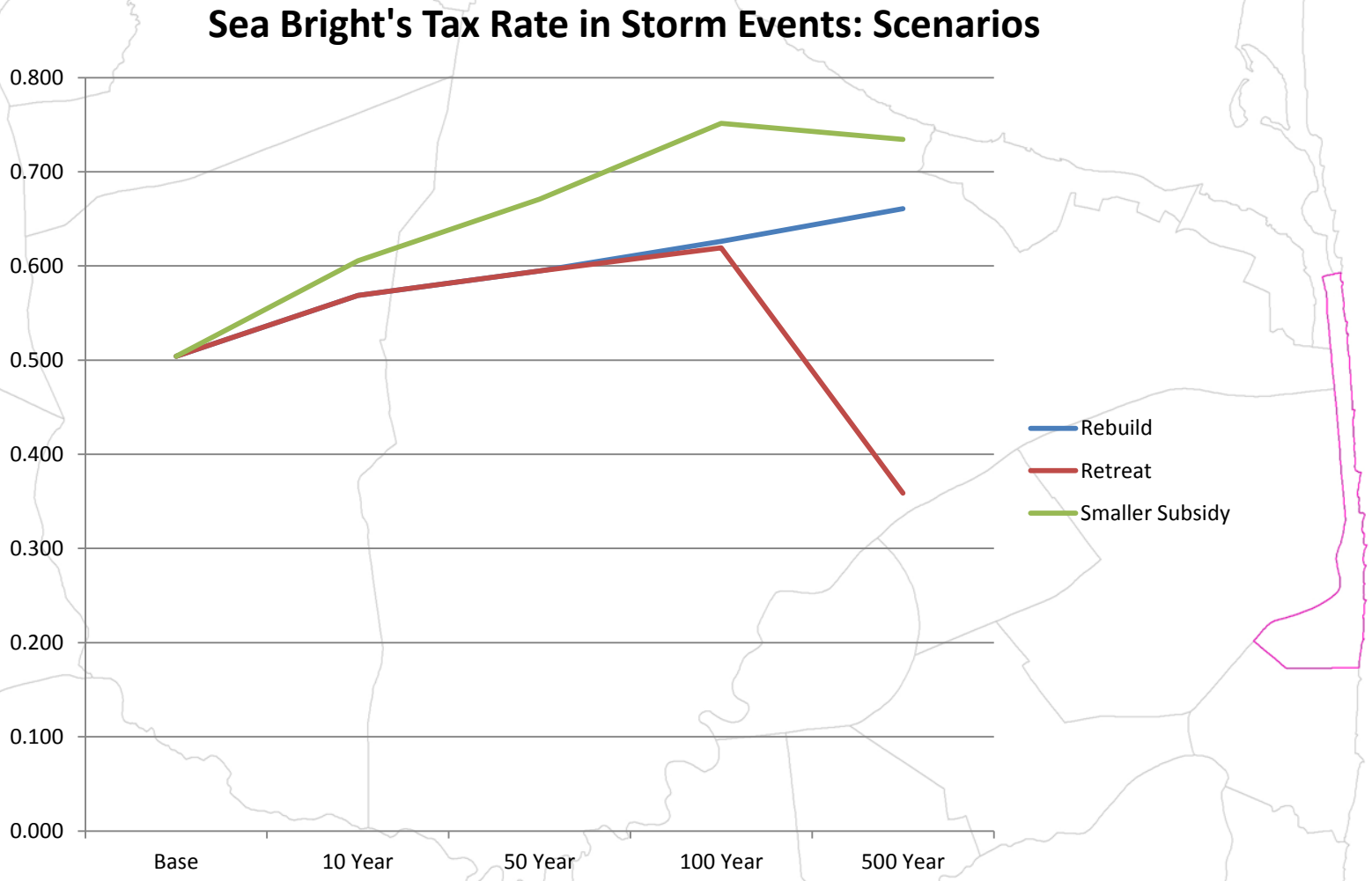
Sea Bright Borough, NJ



The extent of flooding is modeled using FEMA's standardized Hazus methods and LiDAR-based Digital Elevation Models with a horizontal accuracy of 1 meter and a vertical accuracy of 0.6 ft.

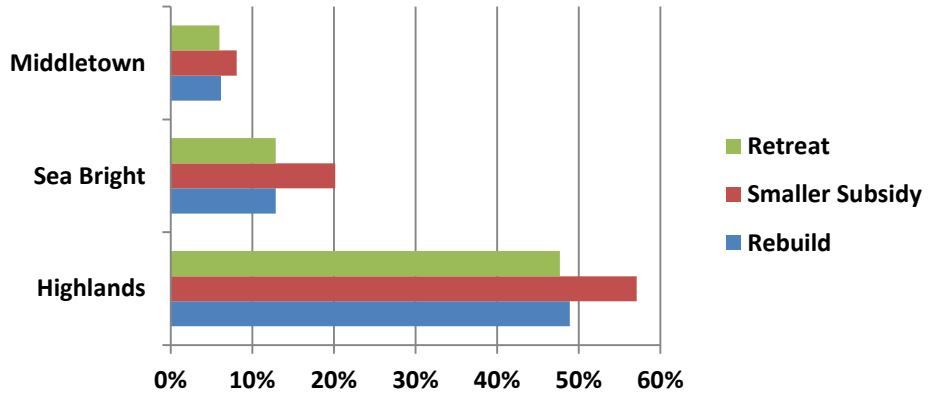
Source: NJDEP, FEMA, Monmouth County,& Bing Maps Hybrid

Sea Bright Fiscal Analysis

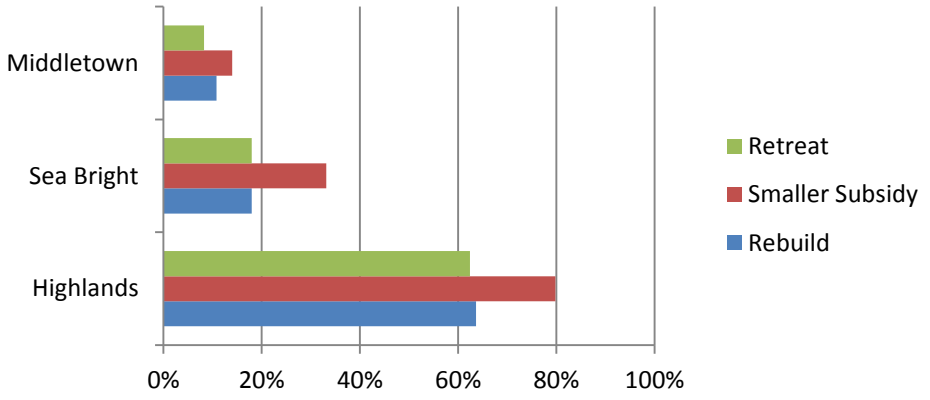


Case Study Comparisons

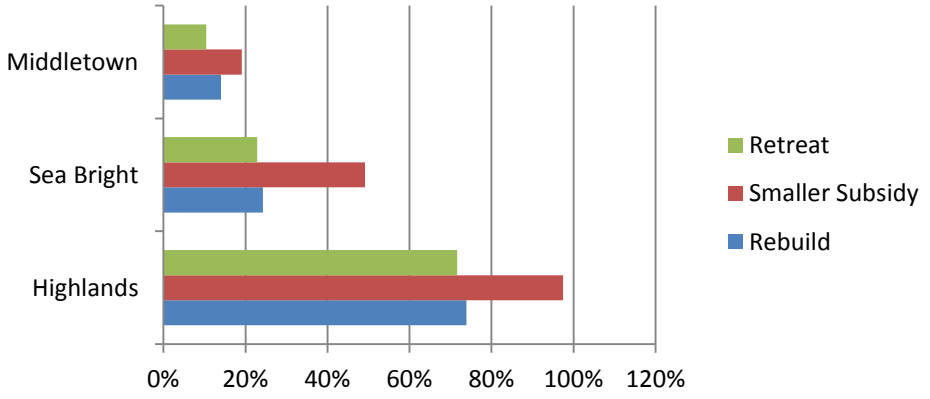
10 Year Storm - Percent Change of Tax Rate



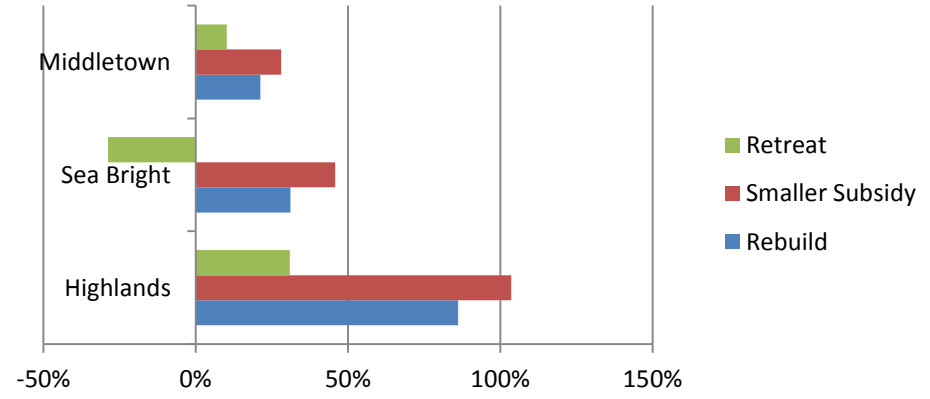
50 Year Storm - Pecent Change of Tax Rate

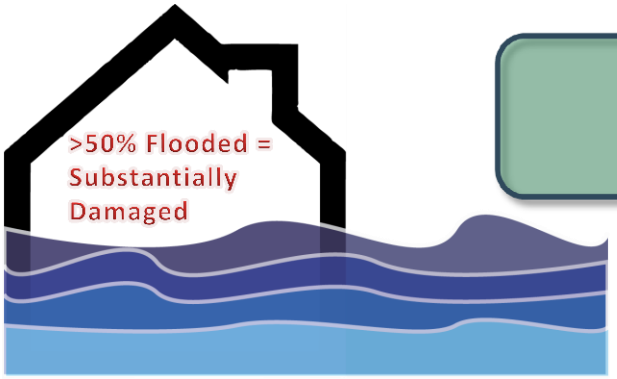


100 Year Storm - Percent Change of Tax Rate



500 Year Storm - Percent Change of Tax Rate





Hazus Analysis

Expected Substantianly Damaged Structures From Flooding

Storm Return Period	Highlands Borough		Sea Bright Borough		Middletown Township	
	Residential	*Commercial*	*Residential*	*Commercial*	*Residential*	*Commercial*
10-yr	90	0	0	0	84	0
50-yr	100	0	1	0	1,455	0
100-yr	161	0	21	1	1,974	0
500-yr	903	1	324	10	4,186	12

Expected Loss of Use to Essential Facilities

Storm Return Period	Highlands Borough				Sea Bright Borough				Middletown Township			
	Fire Stations	*Hospitals*	*Police Stations*	*Schools*	*Fire Stations*	*Hospitals*	*Police Stations*	*Schools*	*Fire Stations*	*Hospitals*	*Police Stations*	*Schools*
10-yr	1	0	1	0	1	0	1	0	0	0	0	6
50-yr	1	0	1	0	1	0	1	0	0	0	0	8
100-yr	1	0	1	0	1	0	1	0	0	0	0	9
500-yr	1	0	1	0	1	0	1	0	0	0	0	15

Adaptation and Mitigation Best Practices

- Municipal Level Modification
  - Incentives to promote infill development in low flood-risk areas
  - Locating new development and critical facilities outside flood-prone areas
  - Reduction of impermeable surfaces
  - Park/open space in floodplains
  - Creation of sand dunes
  - Modernize storm water drains and systems

Mitigation Strategies and Best Practices

- Property Level Modifications
  - Property elevation requirements
  - Reduction of Impermeable Surfaces
  - Setback restrictions for vulnerable properties facing waterfronts
  - Green building techniques
    - Adds strength and longevity to buildings

Mitigation Strategies and Best Practices

- Retreat
  - No new development or redevelopment within determined flood-prone areas
  - Buyout of flood-prone properties
    - Possible adaptive reuse for recreation or natural preservation/buffer areas

Mitigation Strategy Ranking

- Methods
  - Weighting Criteria (high, med, low)
  - Point of View - Society at large, as opposed to local
  - Folding property level strategies into actions
  - Screening of low ranking strategies in order to show top performers
- Criteria
  - Incrementalism
  - Cost
  - Fairness/Equity
  - Impact on Shore (and State) Economy
  - Impact on Environment
  - Impact on Flood Mitigation

Mitigation

- Top Choices (multiple slides if necessary)
- Retreat or Stand your ground?
  - Property Level Modifications
  - Market/Management Responses
  - Municipal/Government Level Modifications

Mitigation Strategies

● High Performance ◒ Medium Performance ○ Low Performance

H = Highlands S = Sea Bright M = Middletown

Mitigation Strategies	Performance: Incrementailsm	Cost	Fairness	Economy	Environment	Flood Mitigation	Implemented	Overall Ranking
Community Rating System Program	●	●	◒	◒	●	●	H,S,M	5
TDR	◒	◒	●	●	●	●	-	5
Abandon Property	●	●	○	◒	●	●	-	4.5
Buyouts	●	○	●	◒	●	●	-	4.5
Reduction Of Impermeable Surfaces	●	◒	◒	◒	●	●	M	4.5
Park Space In Flood Plains	●	◒	◒	◒	●	●	H,S,M	4.5
Mapping	●	◒	●	◒	◒	◒	H,S,M	4
Dunes	●	◒	◒	◒	●	◒	S,M	4
Overlay Zones/Rolling Easements	●	◒	◒	◒	●	◒	M?	4
No New Development Or Redevelopment	●	●	○	○	◒	◒	-	3
Beach Replenishment	◒	○	◒	◒	◒	●	H,S,M	3
Zoning/ Building Code Changes	●	○	◒	◒	◒	◒	H,S,M	3
Canal System	◒	○	◒	●	○	◒	H	2.5
Flood Insurance	◒	○	◒	◒	◒	○	H,S,M	2
Levees & Bulkheads	○	○	●	◒	○	◒	H,S,M	2

The three strategies that have been adopted by municipalities tend to be:

- More costly (to society at large),
- More environmentally damaging; and
- Less effective at flood Control.

Conclusions of Analysis

- Physical threat
- Fiscal
  - Retreat after storm impacts
    - Implementation: Moratorium and rezoning
  - Oncoming small subsidy world
    - Debris removal fund
    - Retreat

Federal incentives diminish effects of storms that would otherwise trigger these responses

Recommendations

Government Officials:

- Curtail federal incentives
- Implement policies of gradual retreat
- Prepare for more severe storms to be the new norm

Planning Professionals:

- Encourage development away from coastal areas
- Encourage natural mitigation techniques
- Encourage the use of permeable ground cover and stormwater management strategies

American Littoral Society:

- Generate tools and information to aid coastal municipalities
- Encourage government officials to adopt the policies we have laid
- Aid municipalities in adapting to coastal climate change.

Acknowledgements

Gabrielle Barnett - Former Sea Bright Renter
Scot Bell - Sea Bright Property Owner
Dr. Cathy Folio - North Middletown Property Owner and Resident
Jason A. Greenspan, PP, ACIP - Director of Planning and Community Development, Township of Middletown
William J. Keeler - Councilman, Borough Sea Bright
David Listokin, PhD - Professor, Bloustein School of Planning and Public Policy at Rutgers University, and Co-Director, Center for Urban Policy Research of Rutgers University
Dina Long - Mayor, Borough of Sea Bright
Margaret Murnane - Deputy Coordinator, Monmouth County Sheriff's Office, Office of Emergency Management
Norb Psuty - Professor, Coastal geomorphology, shoreline erosion, coastal zone management
Stephanie Rinaldi - Port Monmouth, Middletown, Property Owner and Resident
Charles Rogers - Office of Emergency Management ("OEM") - Middletown, NJ
Judd Schechtman - Doctoral Candidate, Rutgers University
Thomas A. Thomas, PP - Former Planning Consultant to Highlands, Middletown and Sea Bright

Sea Bright Public Library Staff
Eastern Branch of the Monmouth County Library Staff

*A special thank you to **Dr. Clinton Andrews** for his guidance and support.


Marcus Ferreira
Zhuosi (Joyce) Lu
Katherine Nosker
Tim Dillingham
Clinton Andrews
Kyle Davis
Christine Bell
Brian Gibbons
Albert Macaulay
Michael Yaffe
Michael D'Orazio